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Author Index

Subject Index

PAGE

PAGE

PAGE

THE EMISSION SPECTRUM OF THE PD+ MOLECULE

N. A. NARASIMHAM AND M. N. DIXIT

Spectroscopy Division, Atomic Energy Establishment, Trombay, 414 A, Cadell Road, Bombay-28

INTRODUCTION

THE spectrum of the PD+ molecule was not known prior to the present investigation though the emission spectrum of PH+ was reported nearly ten years ago.[1] PH+ has an electronic structure similar to the hydrides of the carbon group and, as expected, has a band system (3567–4228 Å) corresponding to the $^2\Delta - {}^2\Pi$ transitions in the CH-type molecules.[2] The spectrum of the isotopic molecule, PD+ has now been obtained in a microwave discharge through phosphorus vapour, deuterium and helium gas. The new emission bands lie at 3683 Å, 3826 Å and 4086 Å. An analysis of their vibrational and rotational structure shows that they are the 1–0, 0–0 and 0–1 bands of PD+ involving the $^2\Delta - {}^2\Pi$ transition. Results of these studies are presented in this article.

EXPERIMENTAL

PH+ was obtained earlier[1] from a hollow cathode discharge through helium containing a little of phosphorus vapour and hydrogen. It was found necessary to maintain a constant flow of helium at 2–3 mm. pressure through the discharge tube. The same method of excitation could not be tried to excite the spectrum of the corresponding phosphorus deuteride because of the limited quantity of deuterium gas available. For this purpose, therefore, sealed-in quartz discharge tubes, containing traces of phosphorus vapour, deuterium and about 3 mm. of helium gas, were prepared in the manner described by Tomkins and Fred.[3] These sealed-in tubes, on excitation with a microwave (2450 mc./s.) discharge, gave new emission bands attributable to PD+.

ANALYSIS OF NEW BANDS

(a) *Vibrational Structure.*—The bands obtained in the present studies are similar to the emission bands of PH+ which are shown in juxtaposition in Fig. 1 (a). Each band contains two sub-bands with $^sR_{21}$, R_1 and R_2, Q_2 heads. These band heads could be arranged into a Deslandres vibrational scheme as shown in Table I. R_1 and Q_2 heads of the 3826 Å band show shifts of 136 cm.$^{-1}$ from corresponding heads of the 0–0 band of PH+ at 3854 Å. The isotope shift

calculated for the 0–0 band of PD+ agrees very well with this value. The other two bands at 3683 Å and 4086 Å have shifts expected of the 1–0 and 0–1 bands of PD+. The isotope shifts thus provide an unambiguous vibrational assignment of the three bands as shown in the Deslandres Table I and further prove that the emitter of the bands is the PD+ molecule.

TABLE I

Deslandres vibrational scheme of the band heads (in cm.$^{-1}$) of PD+

v'' v'		0	$\Delta G''(\tfrac{1}{2})$	1
0	$^sR_{21}$	26125	1663	24462
	R_1	26077	1667	24410
	R_2	25830	1654	24166
	Q_2	25792	1668	24124
$\Delta G'(\tfrac{1}{2})$	..		1615	..	..
	..		1026	..	..
	..		1017	..	..
	..		1013	..	..
1	$^sR_{21}$	27140	..	..
	R_1	27103	..	..
	R_2	26847	..	..
	Q_2	26805	..	..

(b) *Rotational Structure.*—The 3826 Å band which is strongest of the three bands has been photographed on a 6·6 m. concave grating spectrograph at a dispersion of 0·55 Å/mm. and is shown in (b) and (c) of Fig. 1. The two bands involving $^2\Delta_{3/2} - {}^2\Pi_{3/2}$ and $^2\Delta_{3/2} - {}^2\Pi_{1/2}$ transitions are shown separately. Each of the sub-bands contains 12 branches which form close pairs of Λ-doublets. As expected, the Λ-doubling in the $^2\Pi_{3/2}$ state is found to be much smaller at low J values than in the $^2\Pi_{1/2}$ state as a result of which Λ-doubling in the branches of $^2\Delta_{3/2} - {}^2\Pi_{3/2}$ is perceptible only at high J values. Detailed analysis of the rotational structure of the two sub-bands has shown that the $^2\Delta$ state is regular with small spin-splitting (case *b*) while the $^2\Pi$ state is regular with large spin-splitting (case *a*). The rotational constants and the $\Delta G(\tfrac{1}{2})$ values of the $^2\Delta$ and $^2\Pi$ states are given in Table II.

Predissociation of rotational levels with N ≥ 13 of $v' = 0$ of the $^2\Delta$ state of PH+ was earlier observed.[1] In the case of PD+, this would
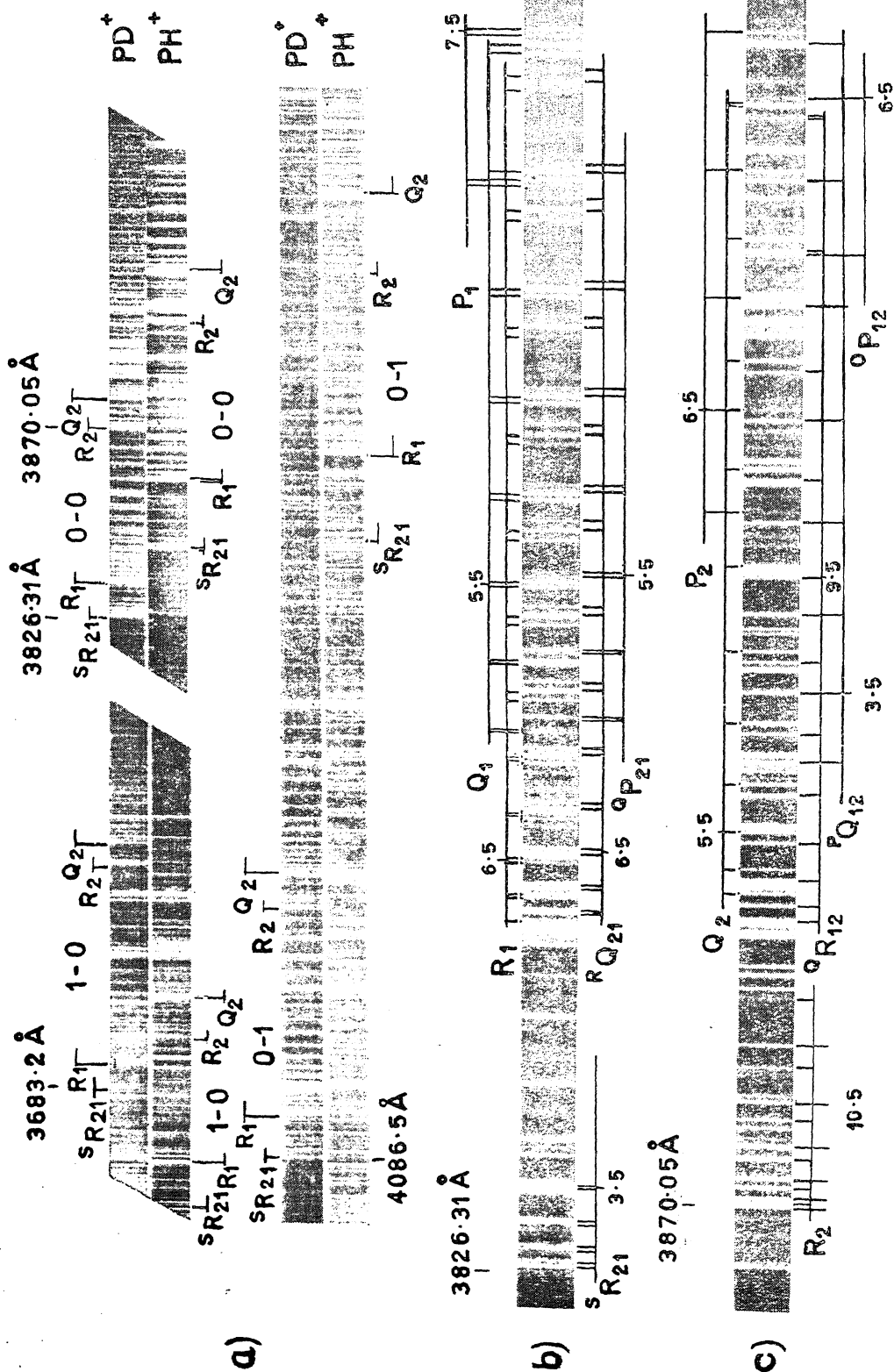
FIG. 1. Emission bands of PH⁺ and PD⁺

TABLE II

Vibrational and rotational constants (in cm.$^{-1}$) of $^2\triangle$ and $^2\Pi$ states of PD^+

State	$\triangle G(\frac{1}{2})$	B_0	$r_0(\overset{\circ}{A})$	D_0	A_0	γ	p
$^2\triangle$	1017	3·635 (3·635)	1·565$_9$	0·001713 (0·0001673)	1·35	0·09$_5$	..
$^2\Pi$	1666	4·350$_5$ (4·345$_2$)	1·431$_3$	0·000116 (0·000111)	295·83	..	0·08

Values in parentheses are calculated ones from B_0 and D_0 of PH^+.

correspond to N $\geqslant$ 17 levels of $v' = 4$. The rotational lines involving N $\geqslant$ 17 levels of $v' = 0$ are either extremely weak or not observed in the 0–0 band of PD^+.

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FOETAL RESORPTION IN BARBITAL SODIUM TREATED PREGNANT RATS

A. V. CHAMPAKAMALINI AND M. APPASWAMY RAO

Department of Zoology, Manasa Gangotri, Mysore-6, India

INTRODUCTION

BARBITURATES are extensively used as sedative, hypnotic, anæsthetic and anti-convulsant drugs. They are known to reduce the adrenocortical secretions and inhibit the pituitary hormone production.[1,2] It is well established that normal pregnancy necessitates a balanced proportion of ovarian and adreno-cortical hormones, which are under the control of anterior pituitary.[3-5] As there is paucity of information regarding the effect of barbiturates on pregnancy,[6] the present investigation was undertaken to study the effect of Barbital Sodium on pregnancy in albino rats.

EXPERIMENTAL

Adult female rats (180–220 gm.) of Wistar strain were mated with fertile males on the day of prœstrus. Rats showing sperms in their vaginal smear on the following morning were selected for the experiment and that day was designated as day 0 of pregnancy. The rats were kept in individual cages at a room temperature of $27 \pm 1°$ C. and maintained on CFTRI chow with water *ad lib*. On day 8 of pregnancy they were laparotomized under ether anæsthesia in sterile condition to note the number of implantation sites. 20 mg. of Barbital Sodium (M & B) in 1 ml. of distilled water per 100 gm. body weight was administered subcutaneously from day 8 to 19 and autopsied on day 20 of pregnancy. The controls received 1 ml. of distilled water per 100 gm. body weight per day. Body weight and vaginal smear were recorded daily. The fœtuses, uteri, ovaries, adrenals and thymus were weighed. The tissues were fixed in Bouin's fluid, sectioned at

10 μ thick and stained with Harris' hæmatoxylin-eosin.

RESULTS AND DISCUSSION

The results indicate that out of 12 pregnant rats treated with Barbital Sodium, 8 show complete resorption of the embryos at autopsy and their uteri resemble those of the non-pregnant rats, despite they possess implantations on the day of laparotomy (Table I, Figs. 1 and 3). In these rats continuous vaginal bleeding has been observed from day 9 to 11 of pregnancy followed by estrus and prolonged diestrus. Out of the remaining 4 treated rats only 1 shows partial resorption (Fig. 4) and the rest 3 possess live fœtuses whose weights are considerably less than those of the controls (Fig. 5). All the controls have normal pregnancy without any significant fœtal resorption (Table I, Fig. 2), wherein the per cent fœtal survival is 92·7, while in the treated it is only 36. Though there is no significant change in the ovarian weight between the controls and the drug-treated rats, histological studies of the ovaries reveal that in the treated rats the corpora lutea are small with many developing follicles, while in the controls the corpora lutea are large.

Barbiturates are known to inhibit the release of pituitary hormones and reduce the adreno-cortical secretions,[1,2] and probably their action is mediated through the hypothalamus.[7] It is well known that hypophysectomy, ovariectomy or adrenalectomy during early phase of pregnancy causes fœtal resorption in rats.[4,8] In the present experiment the fœtal resorption in Barbital Sodium-treated rats may be

TABLE I

Effect of Barbital Sodium on pregnancy in albino rats

Treatment	Number of rats				Mean in relation to pregnant rat at laparotomy M±S.E.		Fœtal survival (%)*	Fœtal weight (gm.)	Organ weight/100 gm. body weight M±S.E.		
	Pregnant at		Showing resorption						Uterus (gm.)	Ovary (mg.)	Adrenal (mg.)
	Laparotomy	Autopsy	Complete	Partial	Implantations	Viable fœtuses					
Controls	5	5	—	—	8·2 ±0·73	7·6 ±0·75	92·7	3·42 ±0·34	15·39 ±4·50	38·65 ±2·98	30·99 ±1·42
Barbital Sodium	12	3 (25·0)	8 (66·7)	1 (8·33)	6·25 ±1·05	1·83 ±1·02	36·0	1·83 ±0·02	3·56 ±1·71	38·20 ±2·59	34·32 ±1·44

Numbers in parentheses denote percentage.   M±S.E. = Arithmetic Mean ± Standard Error.
* Total number of fœtuses/Total number of implantations, × 100.   Probability (P) = .. = > ·05   ... = > ·001.
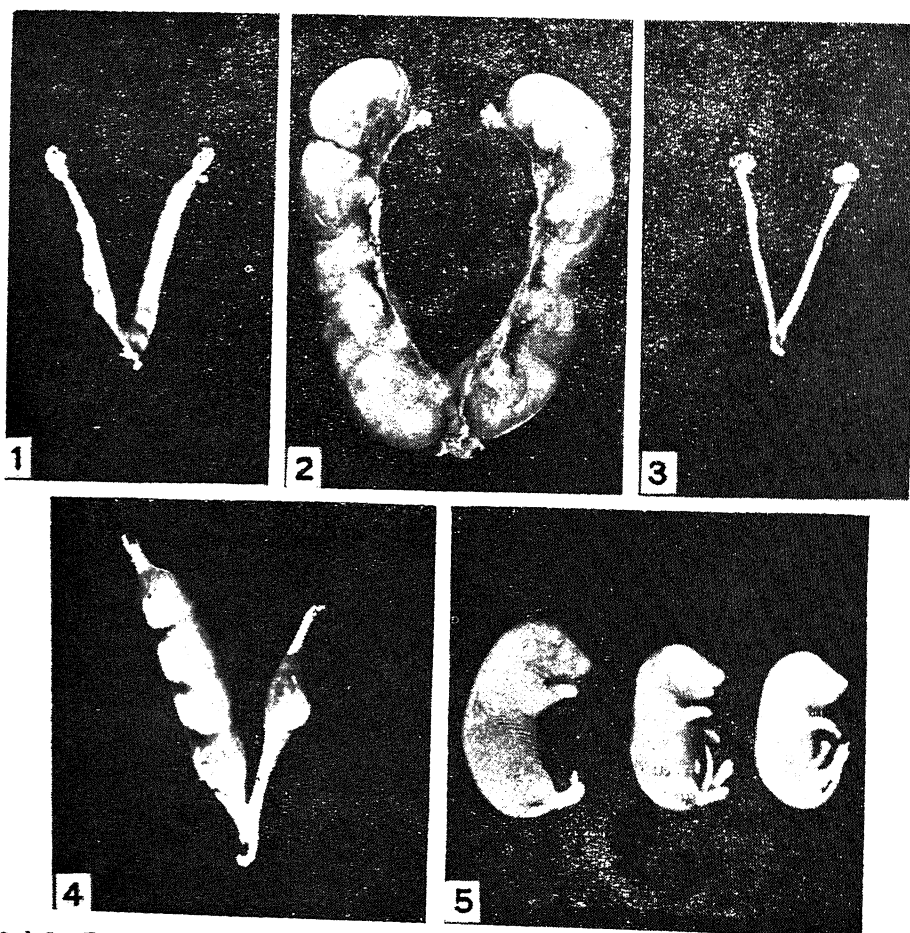
FIGS. 1–5. Fig. 1. Uterus on day 8 of pregnancy showing implantation sites, × 0·6. Fig. 2. Pregnant uterus on day 20 of pregnancy with fully developed fœtuses (control), × 0·6. Figs. 3 and 4. Uteri of Barbital Sodium treated pregnant rats on day 20 showing complete resorption or partial resorption, × 0·6. Fig. 5. Fœtuses of Barbital Sodium treated rats showing retarded growth (T) when compared to ...

due to reduced secretions of ovaries and adrenals. This assumption is further corroborated by the presence of small corpora lutea in the ovaries of treated rats. However, this experiment does not exclude the possibility of the toxic effect of the drug on the developing fœtuses.

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PECTINOLYTIC *AEROMONAS* SPECIES FROM *SISAL* RETS

A. D. AGATE AND J. V. BHAT

Fermentation Technology Laboratory, Indian Institute of Science, Bangalore

IN the course of studies on the aerobic microflora associated with the rets of *Sisal* (*Agave* Linn.) leaves, it was revealed that *Aeromonas* species dominated in 3 out of 6 rets examined up to the eighth day. A total of 44 isolations were made and of these 4 representative strains were examined according to the methods given in the *Manual*.[1] They were placed in the genus *Aeromonas* according to *Bergey's Manual*[2] and their identity was confirmed on the basis of recommendations of Ewing, Hugh and Johnson,[3] Eddy[4,5] and Eddy and Carpenter.[6] A description of characteristics is as follows: Gram negative cocco-bacillary rods, occurring in clusters, motile with one polar flagellum (occasionally tufted flagellar arrangement), colonies on nutrient agar were small to pinpoint, round to oval with irregular margin and transparent periphery, elevated, glistening smooth surface, transparent to translucent. Good growth was observed after 72 hr. at room temperature (about 24–26° C). No fluorescence was detected. Growth in nutrient broth was uniformly turbid with a sediment but without a pellicle. Glucose, glycerol and lactose were fermented with acid and gas, though acidity was only slight. Mannitol was not attacked. All the strains could hydrolyse starch, gelatin and tributyrin; produce indole, reduce nitrates to nitrites, form acid and clot in bromo-cresol purple milk, utilize citrate, decompose pectin and were V.P. positive. They did not produce H_2S and were M.R. negative.

The above attributes resembled to a certain extent with those recorded for *A. punctata* (*A. liquefaciens*)[4,5] as well as for *Aeromonas* (*Pseudomonas*) *pectinovora* sp. nov. of Betrabet and Bhat[7] but differed in other respects (Table I). It will be pertinent to mention that the classification of the latter organism, dominant in the rets of malvaceous plant straws, as *Pseudomonas pectinovora* was based on the system adopted in the 6th edition of *Bergey's Manual*.[8] In the present edition,[2] such polar flagellated aerogenic bacteria are placed in the genus *Aeromonas*.

Examination of the pectinolytic attributes of these isolates was carried out according to the methods described elsewhere[9] and the results are tabulated in Table II. That these strains possessed pectinolytic activity and that polygalacturonic acid was preferred to pectin as substrate is illustrated by the differences in quantities of enzymes secreted in the presence of these substrates. This led to testing the effect of these substrates at 0·5% level in the maintenance medium[10] and capability of the isolates to elaborate pectic enzymes subsequent to their storage. After six transfers, made monthly on these media, the pectinolytic properties of the cultures were rechecked and it was found that whereas the cultures grown on media without either pectin or polygalacturonic acid lost completely their ability to produce pectin enzymes, those maintained on media with pectin retained to an extent the ability to do so. Significantly, the cultures maintained on media with polygalacturonic acid revealed to have retained to the full extent their capacity to attack pectin. All these cultures have since

TABLE I

Differences in the attributes of similar Aeromonas species

Attributes		Present Aeromonas sp.	A. pectinovora[7]	A. punctata[8-6]
1. Utilization of litmus milk *or* BCP milk		Acid and clot	Acid and clot	Peptonized
2. Production of:				
(i) Indole	..	+	Variable	+
(ii) H$_2$S	..	−	+	+
3. Hydrolysis of:				
(i) Gelatin	..	+	−	+
(ii) Tributyrin	..	+	Not known	+
(iii) Starch	..	+	Variable	Variable
4. Decomposition of pectin	..	+	+	Not known
5. Fermentation of:				
(i) Glycerol	..	Acid and gas	−	Acid and gas
(ii) Lactose	..	Slight acid and gas	Acid and gas	Variable
(iii) Mannitol	..	−	do.	Acid and gas

TABLE II

Pectinolytic activity of Aeromonas *sp. from* Sisal *rets*

Strains of Aeromonas	Qualitative screening for enzymes		Quantitative examination of enzyme activity*			
	PE	PG	PE	PG		PTE
				Substrates		
			P	PGA	P	PGA
1	−	+	0	1·2	0·4 0·380	0·182
2	−	+	0	1·1	0·3 0·364	0·153
3	−	+	0	0·9	0·2 0·328	0·137
4	−	+	0	1·1	0·3 0·360	0·155

PE = Pectinesterase,   PG = Polygalacturonase,
PTE = Pectin *trans*-eliminase,   P = Pectin,   PGA = Polygalacturonic acid.

  * Pectinesterase activity as ml. of 0·02 N NaOH required, Polygalacturonase activity as increase in reducing power in terms of ml. of 0·05 N Na$_2$SO$_3$, and *trans*-eliminase activity as increase in O.D. units at 235 mμ, where a peak is obtained.

then been maintained on media containing polygalacturonate without affecting their pectinolytic properties or other characteristics.

The practical importance of this finding may be judged from the fact that in the past conflicting data were reported on the performance of *Aeromonas pectinovora* cultures before and after their storage (for 3-4 years) on pectin media. Generally the cultures failed to attack

pectin. On the other hand, pectinolytic *pectinovora* maintained on polygalacturate a, retained their ability to attack pectin. Thou loss of biochemical activity in cultures ma tained for long period, with frequent transfers, media without appropriate substrates is not i common, this was inexplicable in the case certain pectinolytic bacteria maintained pectin. Maintenance of pectinolytic species polygalacturonate media, in preference pectin media, is therefore recommended for retention of their pectinolytic properties.

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LETTERS TO THE EDITOR

ON A GÖDEL-TYPE UNIVERSE FILLED WITH CHARGED-INCOHERENT MATTER

THERE exists a well-known solution of the Einstein-equations of the gravitational field, exhibiting universal rotation and known as Gödel's homogeneous stationary universe.[1] In this shearless and rotating universe, an infinitesimally small positive charge on the Hydrogen-atom, which stands as a fundamental piece of the universal fluid, is introduced and the situation is investigated under the field-equations of the General Relativity and Relativistic-Electrodynamics. The excess of the positive charge manifests its existence in the smoothed-out distribution of matter, through the presence of universal magnetic-field in the universe.

As a point of conclusion, we are led to a family of Gödel universes containing the charged-incoherent matter and the magnetic field, the line-element for the family being

$$ds^2 = (dx^0)^2 + 2e^{x^1}\,(dx^0)\,(dx^2) + ae^{2x^1}\,(dx^2)^2 + b\,(dx^1)^2 - (dx^3)^2 \qquad (1)$$

where a is the parameter which characterizes any particular member of the family. If the solution is to be physically valid, it becomes essential that we restrict a to the range $\tfrac{1}{2} \leqslant a < 1$ and b to the range $-\infty < b < 0$. Every member of this family represents a rotating universe filled with charged-incoherent matter except in the case when $a = \tfrac{1}{2}$, it reduces to the uncharged Gödel's universe. The mass-density ρ, the charge-density σ and the non-vanishing component F_{12} of the electromagnetic tensor F_{ij} are respectively given by

$$\rho = [16\pi b\,(a - 1)]^{-1},$$
$$\sigma = A\,[b\,(1 - a)]^{-1}$$
$$F_{12} = Ae^{x^1} \qquad (2)$$

where the negative constant A is expressed by the equation,

$$1 - 2a + 16\pi A^2 = 0. \qquad (3)$$

The scalar of expansion and the tensor of shear, both vanish as in the case of Gödel's universe.
Now with a view to envisage the physical situation at a point of the Riemannian-fourfold of the space-time continuum of the present universe, we choose the appropriate tetrads at that point and construct the physical parameters. In the tangent-space at a point of the Riemannian-fourfold of the universe, there exists an electric-field-vector, a magnetic-field-vector and an electric-current-vector. These three vectors are mutually orthogonal, the magnetic-field-vector lying along the direction of the angular-velocity-vector. It is observed that the three vectors, (i.e., the electric-field-vector, the magnetic-field-vector and the angular-velocity-vector) satisfy the relativistic equation,

$$\mathbf{J}^{(0)} = \operatorname{div}\,\bar{\mathbf{E}} - 2\bar{\omega}.\bar{\mathbf{H}}, \qquad (4)$$

$\mathbf{J}^{(0)}$ being the relative-charge-density (Synge[2]).

If we choose the magnetic-field to be of the order of 10^{-6} gauss and the mass-density ρ of the order of 10^{-30} gm./c.c., it is found that the positive-charge-excess on the Hydrogen-atom of the smoothed-out distribution of the matter in this universe, is of the order of $10^{-20}e$ where $-e\;(= -4.806 \times 10^{-10}$ e.s. units) is the charge on an electron. However the order $10^{-20}e$ of the charge-excess found here is in better agreement with the expected value than the value suggested by Lyttleton and Bondi[3] to explain the observed expansion of the universe. This charge-excess explains the presence of the universal magnetic-field of the order of 10^{-6} gauss in the intergalactic space.

The case when the universe is expanding and filled with the charged fluid is at present under investigation.

Department of Mathematics,
University School of Sciences,   H. M. RAVAL.
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SOME INTERESTING GROWTH PATTERNS ON VAPOUR-GROWN CADMIUM SINGLE CRYSTALS

GROWTH patterns originating from two or more screw dislocations on the surfaces of the crystals grown from their vapours and solution have been reported by several investigators on a number of crystals during the past few years. By the application of phase contrast microscopy numerous growth spirals, with shapes ranging from circular to regular hexagonal have been observed by Verma[1] on the (0001) faces of SiC crystals. Double spirals originating from two screw dislocations of the same sign and co-operating spirals originating from more than two screw dislocations of the same sign have also been observed by him on SiC crystals. Similar patterns were observed by Forty[2,3] on the (0001) faces of CdI$_2$ crystals.

Evidences of the growth patterns originating from a group of screw dislocations of like sign has been obtained by the present author on the surfaces of vapour-grown cadmium single crystals. Figure 1 is a micrograph of a (0001) surface of a cadmium single crystal. It shows a curvilinear co-operating double spiral originating from a pair of like screw dislocations. Figure 2 is a micrograph showing a light profile running across the double spiral. Step height of the growth layers is not very large as no appreciable shift in the profile micrograph was noticed. Figure 3 is another micrograph of a (0001) surface of a cadmium single crystal showing three polygonal co-operating growth spirals (marked with A, B and C) originating from a group of like screw dislocations arranged along a line. The growth steps illustrated in Fig. 3 were barely visible through the visual eyepiece of an optical microscope. Even under a phase contrast microscope growth steps could not be resolved. The visibility of these steps was greatly improved by using the decoration technique discussed by Forty.[4]

The cadmium single crystal exhibiting the polygonal co-operating growth spirals was mounted on the plasticine and was exposed to air for about 36 hours. The exposure of the surface to both air and plasticine rendered the growth steps highly visible. The poor visibility of these growth steps indicates that the growth layers are probably of the monomolecular height. The polygonal shape of the co-operating spirals further suggests that the growth of this very

feature might have taken place under the condition of low supersaturation.
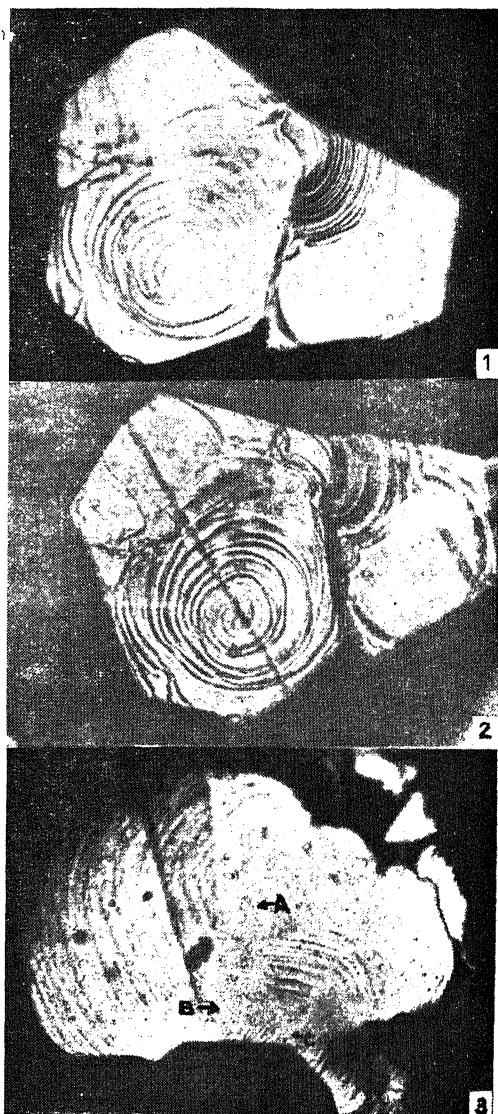
FIGS. 1-3. Fig. 1. Curvilinear co-operating double spiral on a (0001) surface of a cadmium single crystal, × 675. Fig. 2. Light profile running across the co-operating double spiral, × 675. Fig. 3. Polygonal co-operating growth spirals on a (0001) surface of a cadmium single crystal, × 540.

Dept. of Metallurgical Engg., A. S. THATTEY.
Indian Institute of Technology,
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INFRARED ABSORPTION SPECTRUM OF o-FLUOROANILINE

THE ultraviolet absorption spectrum of o-fluoro-aniline has been studied by Shashidhar and Rao[1] and Murty and Santhamma.[2] Kohlrausch, Vogel and Herz[3] have given the extrapolated Raman shifts. Krueger[4] and Thompson and Krueger[5] have studied its infrared absorption in the N–H stretching frequency (3500–3300 cm.$^{-1}$) region.

In the present study, infrared absorption of *ortho*-fluoroaniline, in liquid phase, has been recorded by enclosing the liquid film in between two KBr windows, on a Carl Zeiss Infrared Spectrophotometer Model U.R. 10, which is equipped with KBr, NaCl and LiF prisms. The spectrum lies in the region 4000–400 cm.$^{-1}$ and consists of 45 bands.

The molecule *ortho*-Fluoroaniline, in which, NH_2 group and F atom lie at 1 and 2 positions of the benzene ring, belongs to point group C_s. The 36 vibrational modes will consist of 25 belonging to a' species and 11 to a'' species. The wave-number, relative intensity and assignments of the observed bands are given in Table I. In the assignment of some of the bands, guidance has been taken from the assignments proposed for some of the related compounds.

Authors are grateful to Dr. I. S. Singh and Sri. M. P. Srivastava for their help and to Dr. P. Venkateswarlu of I.I.T., Kanpur, for permission to use the Infrared Spectrophotometer. One of us (S. N. Singh) is also thankful to the C.S.I.R., New Delhi, for financial assistance,

TABLE I

Wave-number cm.$^{-1}$	Intensity	Assignments
404	(8)	C–C out-of-plane bending
436	(9½)	C–C in-plane bending
448	(10)	..
536	(9)	..
656	(9½)	C–C in-plane bending
575	(9)	..
720 (sh)	(9)	NH_2 wagging
758	(10)	C–F in-plane bending
848	(8)	C–H out-of-plane bending
860	(9)	do.
924	(8)	do.
964	(3½)	do.
1028	(9)	C–C stretching (breathing vibration)
1068	(6½)	C–H in-plane bending or N–H out-of-plane bending
1136	(7½)	do.
1155	(8)	do.
1200	(10)	do.
1272	(10)	C–F stretching
1302	(10)	C–N stretching
1328	(9)	C–C stretching
1400	(3½)	..
1472	(9)	C–C stretching
1510	(10)	do.
1584	(10)	do.
1632	(10)	N–H in-plane bending
1756	(3)	..
1848	(1½)	..
1888	(3)	..
1932	(3)	..
1972	(1½)	..
2032	(1½)	..
2264	(1½)	..
2300	(½)	..
2480	(½)	..
2632	(2)	..
2924	(1½)	..
3000	(2)	..
3048	(6)	C–H stretching
3072	(5)	do.
3224	(7)	..
3375	(10)	N–H stretching
3460	(9)	do.
3560	(2)	..
3616	(½)	..
3656	(½)	..

Dept. of Spectroscopy, S. N. SINGH.
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DIELECTRIC RELAXATION IN SOME HALOGENATED BENZALDEHYDES

THE present communication reports the relaxation times of *p*-fluoro-, *o*-chloro- and *p*-chlorobenzaldehydes in the 3 cm. microwave region at 22° C. in dilute solutions. It has been observed that the molecules are relaxed predominantly by the process of overall molecular rotation.

The relaxation times of some aliphatic aldehydes have been determined by Lal[1] who found that the relaxation time increases as the number of –CH$_2$ groups in the chain increases. However, it has been observed that many of the halogenated benzaldehydes have not been investigated for their dispersion behaviour.

The values of the relaxation time and free energies of activation are given in Table I.

TABLE I

Values of the relaxation times τ and free energies of activation for dipole orientation and viscous flow

Polar compounds	$\tau \times 10^{12}$ sec.	Hτ (K.Cal./mole)	Hη (K.Cal./mole)	Hη/Hτ
p-Fluorobenzaldehyde in benzene	5·81	2·10	2·91	1·38
o-Chlorobenzaldehyde in *p*-xylene	11·02	2·50	3·09	1·24
p-Chlorobenzaldehyde in *p*-xylene	9·13	2·36	3·09	1·31

The relaxation time of *p*-fluorobenzaldehyde is found to be smaller than those of chlorobenzaldehydes, as is expected from the smaller size of the former molecule. The relaxation time of *o*-chlorobenzaldehyde is found to be higher than that of *p*-chlorobenzaldehyde. This can be explained on the basis of the fact that the former molecule experiences greater steric hindrance to the free rotation than the latter.

The authors express their gratitude to Dr. P. N. Sharma for his interest and encouragement.

Physics Department, N. K. MEHROTRA.
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THE KINETICS AND MECHANISM OF THE OXIDATION OF ALCOHOLS WITH BROMINE

THE kinetics of the oxidation of simple alcohols with bromine has been studied by a number of workers with a view to formulate the mechanism of the reaction.[1-7] We considered it desirable to study the effect of structural variation in the alcohols on the rate in order to test the mechanisms proposed. We report in this communication the results of the oxidation of a few typical secondary alcohols, propanol-2, butanol-2, α-phenyl ethyl alcohol and benzhydrol. The oxidations were carried out in solvent mixtures of acetic acid and water with the ionic strength maintained constant with A.R. sodium acetate. It has been found that the bromine oxidation of all these alcohols is of the first order in alcohols and in free bromine. This result is in conformity with the earlier reported kinetic picture. The effect of structure on the course of this oxidation is of the following order :

α-phenyl ethyl alcohol > Benzhydrol > propanol-2 ; butanol-2 > propanol-2.

TABLE I

Second order constants for the oxidation of alcohols by bromine in 70% HoAc-H$_2$O (V/V) at 45° C.

Alcohol	$k_2 \times 10^2$ litre mol.$^{-1}$ sec.$^{-1}$
Propanol-2	1·562
Butanol-2	2·800
α-Phenyl ethyl alcohol	10·570
Benzhydrol	5·122

The general trend noticed in the above sequence is justifiable on the basis of both the Swain[4] and the Barker[7] mechanisms proposed for the oxidation. The former mechanism is represented thus :

$$Br - Br \quad H-C-O-H \leftarrow OH_2 \longrightarrow$$

with R groups on the central carbon.

$$Br^- + HBr + RCOR + H_3O^+$$
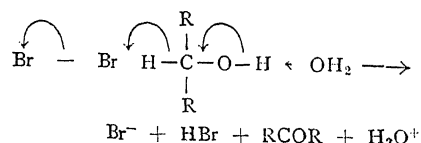
and the latter mechanism is a cyclic one

$$\underset{R'}{\overset{R}{>}}C\underset{H}{\overset{O-H}{<}} \quad \underset{Br}{\overset{Br}{|}} \longrightarrow \underset{R'}{\overset{R}{>}}CO + 2HBr$$
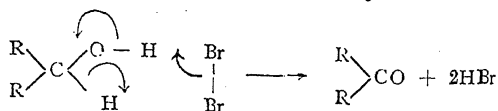
The increase in the rate of oxidation of butanol-2 over propanol-2 is obviously due to the $+I$ effect of the β-methyl group facilitating hydride abstraction and also due to the hyperconjugative stabilisation of the positive charge

on the carbinol carbon atom in the transition state. This stabilisation would be by a mesomeric shift of electrons in the case of α-phenyl ethyl alcohol resulting in a higher rate benefit.* But the decreased rate of benzhydrol over α-phenyl ethyl alcohol is surprising. While two phenyl rings should stabilise the carbonium ion-like transition state to a larger extent than one, the considerable constriction of the C–H bond (because of the three strong-I substituents attached to the α-carbon atom) would oppose a rate-determining breakage of the –C–H bond resulting in reduced rate. An alternative and attractive possibility is that while for α-phenyl ethyl alcohol (or in general for a secondary alcohol with a β hydrogen atom) an alternative or parallel mechanism is available, which is totally absent for benzhydrol.

$$R-\underset{\overset{|}{OH}}{\overset{\overset{H}{|}}{C}}-CH_3 \xrightarrow[slow]{Br_2} R-\underset{\overset{|}{OH}}{\overset{\overset{Br}{|}}{C}}-CH_3 \xrightarrow[-HBr]{fast}$$

$$R-\underset{\overset{|}{OH}}{C}=CH_2 \longrightarrow R.CO.CH_3$$
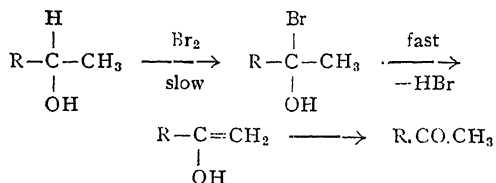
This type of oxidation route has been suggested for the N-Bromosuccinimide oxidation of primary and secondary aromatic alcohols having the –OH group on the carbon adjacent to the aromatic nucleus.[8-10]

Preliminary investigations on the effect of solvents on the rate of oxidation indicate that the rate of the reaction falls with increasing proportions of acetic acid in solvent mixtures of acetic acid and water. This points to the fact that the reaction is essentially one of the dipole-dipole type.

Dept. of Chemistry,   V. THIAGARAJAN.
Vivekananda College,   N. VENKATASUBRAMANIAN.
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SYNTHESIS OF SOME NEW C-, AND N-*BIS* (BENZOQUINONES)

THE isolation of vilangin and its synthesis[1] has initiated this further study of the reactivity of various dihydroxybenzoquinones in undergoing ready condensation with both aldehydes and nitroso compounds. Rapanone (I) isolated from *Ardisia macrocarpa* Wall[2] in these laboratories has now been condensed with various aldehydes to give new methylene-bis-benzoquinones of types II and III while with nitroso compounds, the corresponding N-*bis* (anhydrobenzoquinones) (IV) are obtained. They are further characterized by the preparation of the acetates of their reduction products thus confirming our earlier proposals with regard to the nature of these condensations using embelin[3] and 2, 5-dihydroxybenzoquinone.[4] Tables I and II give a summary of the condensations carried out.

(II, R-Substituents)

(I)

(III, R-Substituents)

(IV, R-Substituents)

Letters to the Editor
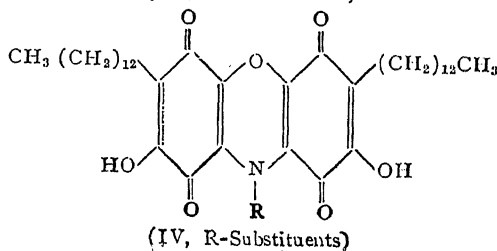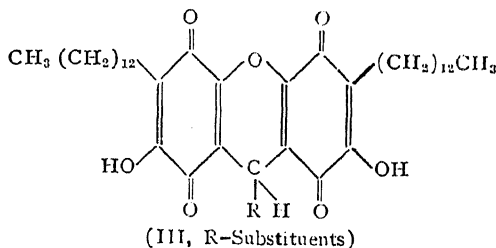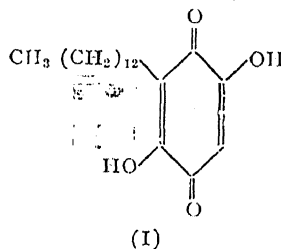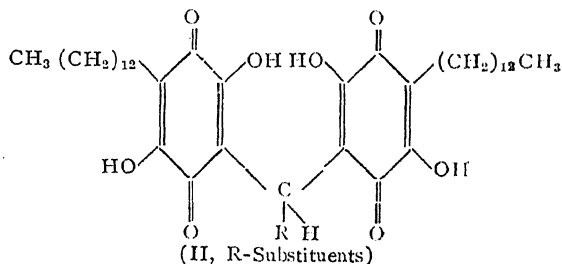
TABLE I

Condensation of rapanone with aldehydes

Aldehyde	Product	Appearance M.P. (°)		Reductive acetate (colourless) M.P. (°)
Formaldehyde ..	II and	Bright yellow	245–247(d.)	168–170
	III, R = H	Brown	150–152	222–224
Acetaldehyde ..	II and	Orange yellow	131–132	..
	III, R = CH₃	Orange brown	166–168	156–158
Propionic aldehyde ..	II and	Orange yellow	127–129	..
	III, R = C₂H₅	Deep orange yellow	138–139	120–122
Benzaldehyde ..	II and	Light orange yellow	108–110	..
	III, R = phenyl	Orange red	150–151	94– 96
Cinnamic aldehyde ..	III, R = phenylvinyl	Golden-yellow	184–186	138–140
Anisaldehyde ..	III, R = p-methoxyphenyl	Orange red	129–131	92– 94
p-Dimethylaminobenzal-dehyde	III, R = p-dimethylaminophenyl	Brown red	132–134	68– 70
m-Nitrobenzaldehyde ..	III, R = m-nitrophenyl	Bright yellow	101–102	71– 73
2, 6-Dimethoxybenzal-dehyde	III, R = 2, 6-dimethoxyphenyl	Violet brown	204–206	141–142
Veratraldehyde ..	III, R = 3, 4-dimethoxyphenyl	Dull orange red	134–136	102–104
Vanillin ..	III, R = 4-hydroxy-3-methoxyphenyl	Deep scarlet red	234–236	88– 90
o-Vanillin ..	III, R = 2-hydroxy 3-methoxyphenyl	Scarlet red	127– 29	200–202
Salicylaldehyde ..	III, R = 2-hydroxyphenyl	Scarlet red	146–148	180–181
o-Methoxybenzaldehyde ..	III, R = 2-methoxyphenyl	Brown yellow	139–141	108–110
Heliotropin ..	III, R = 3, 4-methylenedioxyphenyl	Orange red	105–107	98–100

TABLE II

Condensation of rapanone with nitroso compounds

Nitroso compounds	Product	Appearance M.P. (°)		Reductive acetate (colourless) M.P. (°)
p-Nitrosodimethylaniline	IV, R = p-dimethylaminophenyl	Brown	290–292	140–141
p-Nitrosodiethylaniline ..	IV, R = p-diethylaminophenyl	Violet brown	320	102–103
4-Nitroso-1-naphthol ..	IV, R = 4-hydroxyl-naphthyl	Light brown	140–142	106–108
2-Nitroso-1-naphthol ..	IV, R = 1-hydroxy-2-naphthyl	Red brown	125–127	108–110
1-Nitroso-2-naphthol ..	IV, R = 2-hydroxy-1-naphthyl	Dark brown	152–154	110–112
p-Nitrosophenol ..	IV, R = 4-hydroxyphenyl	Orange brown	134–136	110–112
p-Nitroso-o-cresol ..	IV, R = 4-hydroxy-3-methylphenyl	Violet brown	138 -139	85– 87

Fuller details will be published elsewhere.

Dept. of Chemistry,
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Andhra University,
Waltair, *July* 7, 1966.

V. KRISHNA MURTY.
T. V. P. RAO.
V. VENKATESWARLU.

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o-AMINO-BENZALDEHYDE CONDENSATIONS : FORMATION OF SOME 2-QUINOLONES

LITERATURE available on the synthesis, properties and uses of 2 and 4-quinolones is extensive.[1-3] Chakravarti[4] obtained quinolone derivatives from alkaloids. Recently Fryer *et al.*[5] prepared 2-quinolone derivatives in 50-90% yield.

This communication deals with the synthesis of some new 2-quinolones by the condensation of o-amino-benzaldehyde with some substituted malonic esters like ethyl malon-anilate, ethyl malon-o, m- and p-chloranilates, ethyl malon-o, m- and p-toluidates, ethyl malon-p-phenetidate and ethyl malon-o-anisidate. These esters were prepared by well-known methods.[6,7] The

TABLE I

S. No.	Name	Formula	m.p. (°C.)	Yield %	Nitrogen %	
					Found	Required
1	R-anilide	$C_{16}H_{12}O_2N_2$	339	90	10·86	10·6
2	R-o-chloranilide	$C_{16}H_{11}O_2N_2Cl$	> 360	80	9·91	9·38
3	R-m-chloranilide	$C_{16}H_{11}O_2N_2Cl$	358	66	9·72	9·38
4	R-p-chloranilide	$C_{16}H_{11}O_2N_2Cl$	> 360	90	9·83	9·38
5	R-o-toluidide	$C_{17}H_{14}O_2N_2$	320	100	9·96	10·07
6	R-m-toluidide	$C_{17}H_{14}O_2N_2$	300	100	9·86	10·07
7	R-p-toluidide	$C_{17}H_{14}O_2N_2$	346	100	9·86	10·07
8	R-p-phenetidide	$C_{18}H_{16}O_3N_2$	315	84	9·51	9·09
9	R-o-anisidide	$C_{17}H_{14}O_3N_2$	298	90	9·66	9·52

R-stands for 2-Quinolone-3-Carboxy-

general method followed for preparing the quinolones is illustrated by the following example.

A mixture of o-amino-benzaldehyde (·6 g.), ethyl malon-anilate (1 g.) and piperidine (0·1 ml.) was heated on a steam-bath for 3 hr. The mass was then washed with hot water (15 ml.) and filtered. The product was insoluble in most of the common organic solvents. It was repeatedly washed with hot ethanol, filtered and dried. Colourless crystals of 2-quinolone-3-carboxy-anilide, yield 1·2 g, 90% and m.p. 339° C. were obtained. The I.R. spectrum shows a band at 1670 cm.$^{-1}$ characteristic for amide I band in secondary amides, mainly due to $>C=O$ in the ring and another band at 1645 cm.$^{-1}$ assigned to $>C=O$ which is not in the ring.

The quinolones prepared were mostly white in colour and their yields varied from 66 to 100%. The analytical results, m.p., etc., of these quinolones are given in Table I.

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INDUCED SYNTHESIS OF COENZYME Q IN YEAST ADAPTING TO OXYGEN

OXYGEN adaptation of anaerobically grown yeast is known to be associated with profound metabolic changes in the cell. Induction of catalase,[1,2] cytochromes,[3-5] citric acid cycle enzymes[6-8] and the build up of mitochondria[9-11] have been reported in cells adapting to oxygen.

Formation of coenzyme Q in anaerobically grown yeast on aeration has been demonstrated by Sugimura and Rudney.[12]

With a view to ascertain whether this increase in the coenzyme Q content of the cells of *Saccharomyces cerevisiae* is akin to the induction of protein synthesis, the effect was studied of 8-azaguanine, which was shown to inhibit the induction of catalase under these conditions.[2] Methods used for growth, oxygen adaptation and the assay of catalase are already described.[2,13] Coenzyme Q was extracted from 5 gm. dry weight cells essentially according to the procedure of Festenstein *et al.*[14] and estimated spectrophotometrically in ethanol solution at $275 \, m\mu$ employing $E_{1 \, cm.}^{1\%}$ value of 247. Table I summarizes the observations.

TABLE I

Biosynthesis of coenzyme Q on aeration in S. cerevisiæ : Effect of 8-azaguanine

Cells	Catalase Activity Kat f	Coenzyme Q mg./kg. dry weight
Unaerated	138	19·2
Aerated	896	198·0
Aerated with 8-azaguanine	534	131·0

8 Azaguanine was added at 64 μ moles per 10 ml. of aeration medium consisting of glucose 1%, KH_2PO_4 1%, $MgSO_4 \cdot 7 \, H_2O$ 0·01% and $CaCl_2$ 0·01% ; pH 6·8.

It was noted that the coenzyme Q concentration of the cells rises to about 10 times the anaerobic level on aeration for 4 hours under practically non-proliferating conditions. Although the discrete mitochondria may not have been built up during this period,[10] the synthesis of electron-carriers has already been initiated. In other words, for the biogenesis of coenzyme Q in particular the mitochondrial organization does not appear to be essential.

The observed depression in coenzyme Q content in presence of 8-azaguanine is interesting. This indicates that either the antimetabolite

interferes at some stage in the biosynthetic pathway of coenzyme Q, or, more probably, it is inhibiting the synthesis of the enzyme (or enzymes) involved. With the latter assumption the possibility suggests itself that not only is the synthesis of the respiratory enzymes an adaptive phenomenon but also of enzymes involved in the synthesis of some of the respiratory cofactors. These enzymes are thus apparently not necessarily mitochondrial.

Dept. of Chemical Technology,   G. A. SULEBELE.
University of Bombay,   D. V. REGE.
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OBSERVATIONS ON THE EFFECT OF ATP, ADP AND AMP ON THE 5-HYDROXYTRYPTAMINE CONCENTRATION IN RAT BRAIN

ADENOSINE triphosphate is known to bind 5-hydroxy tryptamine (5 HT), the amount of which varied with the content of the former in the platelets (Born *et al.*, 1958).[1] Baker *et al.* (1959)[2] obtained further evidence of this by finding that when homogenised platelets are centrifuged, 5 HT and ATP were separated in the same dense layer. These observations are suggestive of the possibility of similar bindings of 5 HT and ATP in other tissues also. As ADP and AMP are closely related to ATP, the effects of these three purine compounds on the 5 HT concentration of rat brain has been investigated in this study.

Adult albino rats, weighing between 100–120 gm. were injected intraperitoneally with ATP, ADP and AMP each in a dose of 40 mg./ Kg. body weight, and sacrificed after 2 hours. Their brain was removed, dried between folds of filter-papers and weighed. 5 HT was extracted by the method of Feldberg (1953)[3] and estimated biologically on atropinised isolated rat uterus, sensitised by prior injection of an oestrogen (Erspamer, 1953).[4]

TABLE I

Showing the effect of ATP, ADP. and AMP (40 mg./Kg.) on the 5 HT concentration in rat brain, the observations being the averages of five readings in each case

No.	Drug	5 HT concentration in μg /gm. $\pm$ S.E.	Significance ratio
1	Control ..	0.41 ± 0.015	..
2	AMP ..	0.63 ± 0.051	4.10
3	ADP ..	0.47 ± 0.015	2.85
4	ATP ..	1.45 ± 0.064	16.00

It will be observed that 5 HT concentration in brain increased after ATP and AMP, the effect of ATP being more marked and significant. The increase in 5 HT level could possibly be due to increased binding of this amine with a consequent increase in the concentration.

Department of Pharmacology,   B. C. BOSE.
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FLUORSPAR MINERALIZATION RELATED TO CARBONATITE-ALKALIC COMPLEX AT AMBA DONGAR, GUJARAT STATE

SUBRAMANIAM AND PARIMOO (1963) published a note regarding fluorspar mineralization at Amba Dongar, Gujarat State. In this they suggested that the source of fluorine for the formation of fluorite was from the magma chamber which supplied large volumes of Deccan basalts. We quote : "The source of the fluorine is believed to be the magmatic fluids emanating from the magma chamber which supplied the large volume of Deccan basalts. The possibility of basaltic magma of the character of Deccan basalts containing mineralizing solutions which would be deposited in a suitable host rock during their eruptive emplacement had not been given serious thought in the past. It would

appear that at Amba Dongar these conditions have been fulfilled and that the mineralizers released during the fumarolic stage reacted with the host rocks, forming flourspar."

Sukheswala and Udas (1963) published a note almost simultaneously mentioning the occurrence of the carbonatite in Amba Dongar. Since then a second revised and enlarged version of the foregoing note by the same authors (Subramaniam and Parimoo, 1964) has appeared. In this they write : "The volcanic rocks in the area are basaltic flows, flow breccias, agglomerates and volcanic breccia, tuffs, lithic tuffs and dykes of mafic syenite, felsic syenite, dolerite, micro-gabbro" (p. 443), and conclude : "The source of the fluorine responsible for this remarkable mineralization is believed to be the magmatic fluids emanating from the magma chamber which supplied the large volume of Deccan basalts and variants" (p. 446).

Sukheswala and Udas have since worked in the area for considerable length of time and have arrived at conclusions quite different from those of Subramaniam and Parimoo. It is for this reason that this note is written.

Our close scrutiny of the area including detail mapping and laboratory work has established the presence of a carbonatite-alkalic complex in Amba Dongar (Sukheswala and Udas, 1963 ; 1964). We are also convinced that the source of fluorine is not the Deccan basalt magma as believed by Subramaniam and Parimoo ; but the source for fluorine has to be sought in the carbonatite-alkalic magma which perforated the Bagh sediments and the Deccan basalts. To say so the following evidences collected by us need to be related.

1. The geology of Amba Dongar may be summarised as :

Carbonatite-alkalic complex
Deccan Trap basalts
      Minor Unconformity
Bagh sediments (sandstones, limestones),
   Late Cretaceous
      Major Unconformity
Pre-Cambrian metamorphics (Dharwars).

Two types of carbonatites, *viz.*, sovite and brown silico carbonatite have been recognised. The brown silico carbonatite is the younger of the two and forms vertical plugs. Subramaniam and Parimoo have failed to notice the existence of carbonatite and allied rocks.

2. Structurally Amba Dongar hill is a site of extinct volcano dissected by radial and arcuate faults. The fault zones are filled with alkaline rocks identified mainly as nephelenites and not 'mafic syenite, felsic syenite' as reported by

Subramaniam and Parimoo (*op. cit.*, p. 443). The alkaline rocks have developed ring-dyke structures, and are now exposed at Mongra, Kariapani, Kukudwah nullah.

3. The carbonatites (sovite and brown silico carbonatite) are the repositories for fluorite deposits either occurring as huge veins or in granular disseminated form. It is not possible for us to agree wholly with Subramaniam and Parimoo's contentions that "fluorspar mineralization is confined to calcareous facies of Nimar sandstone underlying the Deccan basalts and related pyroclastics" (1964, p. 444).

4. From the field data that we could collect we feel that the fluorite is not essentially "a bedded replacement type of deposit" as claimed by Subramaniam and Parimoo (1964, p. 446), for nowhere the Bagh sandstones and limestones show such concentration of bedded fluorite deposits of a replacing nature. We strongly believe that the fluorite is mainly restricted to sovite and brown silico carbonatite, with possible pocket or large-scale developments in the favourable host rock, *i.e.*, calcareous Nimar sandstones and limestones. These observations of ours find support in the remarks of Subramaniam and Parimoo (1964) also who write : "the fluorspar rocks are composed mainly of fluorite, quartz, and carbonates (mostly calcite with subordinate dolomite and ankerite) with minor amounts of a manganese oxide mineral, barytes, potash felspar, hydrated iron oxides and clay minerals" (p. 444).

From the arguments stated above we are of the opinion that it was not the Deccan basalt magma which supplied fluorine ; but the fluorine emanations out of the carbonatite-alkalic magma were responsible for the formation of fluorite in Amba Dongar. Fairly widespread exposures of Deccan basalt as sills and dykes in the Bagh sediments are exposed to view in this and surrounding areas. But nowhere at such contacts has fluorspar mineralization occurred as in carbonatites of Amba Dongar. This further confirms our argument that the fluorine emanations were from the carbonatite magma and not the Deccan basalt magma.

True, the fluorite deposits of Amba Dongar are in a setting of Deccan Trap eruptive lavas. But mere occurrence of fluorite in such an environment does not prove that the Deccan basalt magma supplied the fluorine emanations. Unless the tholeiitic basalt magma is taken as parental to carbonatite-alkalic magma, there is no evidence to believe that the Deccan basalt magma was responsible for flourspar

mineralization in Amba Dongar. And in the existing state of knowledge it is difficult to derive carbonatite-alkalic magma out of tholeiitic basalt magma on considerations of pure fractional crystallization.

Geology Dept.,   R. N. Sukheswala.
St. Xavier's College, Bombay-1.
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AN UNUSUAL OCCURRENCE OF ASBESTOS IN MANGANESE ORES

The occurrence of asbestos in manganese ores in any part of the world is rather rare and peculiar. However, Fermor[1] has mentioned its presence at the Kajlidongri manganese mine (22° 57′ : 74° 31′), Jhabua District, Madhya Pradesh, which is perhaps the only locality in India where it has been found so far. It is of no commercial value, but presents an academic interest because of its paragenetic relationship with the manganese ores.

At Kajlidongri the asbestos occurs in the manganese ores as veins which vary from 1 mm. to 11 mm. (Fig. 1), usually parallel to
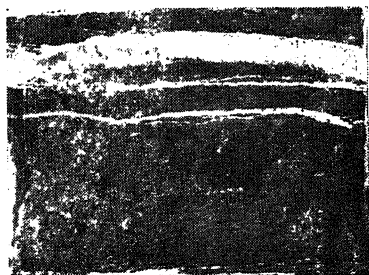
FIG. 1. Asbestos veins showing a sharp contact relationship with the manganese ore (A hand specimen, ¼ natural size).

one another and showing a sharp contact relationship with the ores. They are not seen more than a few feet in length. Quartz-veins are usually encountered in association with them. The mineral is white in colour although yellowish, straw-yellow and in one instance faint bluish colours are also observed. Hardness is variable from 4 to 6, luster-silky, and

streak-white. A suture line is seen in the mineral. Careful examination shows that the nature of the fibres is usually of the cross type, though mass and slip fibres are also detected. Microscopic study of the manganese ores containing the mineral reveals that it occurs as long prismatic fibres, sometimes aggregated closely to give a massive appearance. The cleavage is perfect, but partings and cracks are not uncommon. The associated minerals identified are : calcite, quartz, plagioclase feldspars and rarely winchite. The physical and optical characters definitely confirm the identity of the mineral as an amphibole asbestos. In no case, however, is amphibole cleavage seen, and this may possibly be due to the extreme thinness of the individual fibres.

In general, the various theories subscribed to explain the origin of fibrous veins are mostly restricted to chrysotile asbestos because of its greater economic utility. In the present study, the presence of a suture line in the asbestos indicates that it must have formed in open fissures. The question arises as to where the material came from for the formation of asbestos veins. Considering the field occurrence and environmental factors, there seem to be two possibilities which may satisfactorily explain their origin : (1) the country and the surrounding rocks supplied the material, and (2) the quartz-veins themselves brought the material necessary to form the asbestos veins. Presuming that the material was derived from the surrounding rocks, then its contact with the manganese ores should not be so sharp, but, as seen in Fig. 1, it is quite sharp. The second alternative explains more facts, according to which the residual pegmatitic solutions rich in soda and other mineralizers filled the fractures synchronously with the folding movements, thus resulting in the formation of asbestos veins.[2] Therefore based on field relationship and other evidence, it is envisaged that the asbestos veins owe their origin to pegmatitic activity in the area. A more or less similar occurrence of asbestos, though not in manganese ores, has been described from Camp Albion, Boulder County, Colorado, U.S.A., where a hypogene origin related to the granitic history of that region is attributed.

At this place, it may be mentioned that Fermor (*op. cit.*) also referred to the doubtful occurrence of carpholite at the Kajlidongri mine. This was based on its outward resemblance to the carpholite specimen available in the collection of the Geological Survey of India. During the present investigation, the material

resembling Fermor's description of carpholite was subjected to a detailed examination, but was identified to be only an amphibole asbestos. This was further confirmed by X-ray determination made on the material.

The author is grateful to Prof. W. D. West, under whose supervision this work was undertaken. Thanks are also due to Prof. Th. G. Sahama of the University of Helsinki, Finland, for kindly making the X-ray determination of the carpholite-like material, and to the Ministry of Scientific Research, Government of India, for the award of a scholarship during the course of a mineralogical investigation of the Kajlidongri mine.

Centre of Advanced Study   V. K. Nayak.
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ASCORBIC ACID IN MUSCULAR FATIGUE

Muscles undergo fatigue when they are exposed to repeated stimuli either direct or through a nerve. It was observed that the onset of fatigue is not due to exhaustion of energy-yielding substrates,[1] but due to the inactivation of metabolic enzymes.[2,3] Ascorbic acid level was found to alter during muscular fatigue.[3,4] It was also observed that changes in ascorbic acid level alter activity of enzymes[2] and contractile phenomenon.[5] As changes in ascorbic levels may have a possible role in the activity of muscles, it was felt that estimation of the levels of derivatives of ascorbic acid metabolism may give precise information about its relation to muscular fatigue.

Rana hexadactyla were double pithed and the gastrocnemius muscles were isolated from both the legs with least injury. They were washed four times in amphibian Ringer's solution[6] and allowed to stand for 10 minutes to recover from shock effects. Diketogulanic acid (DKA), dehydroascorbic acid (DHA) and ascorbic acid (AA) were estimated by the differential method for determination of AA, DHA and DKA by Roe *et al.* (1948).[7] DKA was totally absent. AA was detected (Table I) while DHA was in traces.

A fresh batch of paired muscles were obtained. One of the pairs was subjected to

repeated stimuli of 100 pulses per minute with a 6 volts DC applied through platinum wires connected to an electronic source. The set-up was kept in a glass container flushed with nitrogen. The temperature was maintained at 30° C. After the onset of fatigue the muscle was quickly chilled to 0° C. so that the residual metabolism is inactivated. The other muscle of the pair was maintained in a similar environment, but not exposed to stimuli, and chilled to 0° C. DKA, DHA and AA were estimated (Table II *a*). AA decreased while DHA increased; and DKA appeared and was present in significant concentration. It appeared that AA has been metabolized to DHA and DHA in its turn metabolized further to DKA during the muscular fatigue.

TABLE I
Diketogulanic acid, dehydroascorbic acid and ascorbic acid levels in the gastrocnemius muscle of frog, expressed in mg. per gram wet weight

DKA	DHA	AA
Nil	0·0843 ±0·0114	0·2096 ±0·0186

TABLE II
Diketogulanic acid, dehydroascorbic acid and ascorbic acid levels in the control muscle expressed in mg. per gram wet weight of the gastrocnemius muscle of frog

a Muscle	DKA	DHA	AA
Muscles fatigued by direct stimulation			
Control ..	Nil	0·0824 ±0·01851	0·1777 ±0·03
Experimental ..	0·276 ±0·03347	0·119 ±0·03436	0·135 ±0·0353
b Muscle	DKA	DHA	AA
Muscles fatigued by stimulation through sciatic nerve			
Control ..	Nil	0·1073 ±0·02142	0·235 ±0·0603
Experimental ..	0·235 ±0·06701	0·22 ±0·0565	0·162 ±0·01347
c Muscle	DKA	DHA	AA
Muscles induced to fatigue by exposure to fatigue fluids			
Control ..	Nil	0·1331 ±0·02228	0·285 ±0·03081
Experimental ..	0·361 ±0·04204	0·214 ±0·03705	0·029 ±0·01747

During direct stimulation it is possible that the applied electric stimulus may not dissipate

all throughout the muscle uniformly and possibly could have diffused only into the superficial fibres leaving the central core of fibres untouched. In the central core these substances could not be altered or the metabolic conversion could be reverse. Moreover, this type of stimulation does not occur naturally. Hence it was felt that stimulation through sciatic nerve would be more natural than the direct stimulation and that it will reach all the fibres in a muscle and hence this method was adopted on a fresh batch of muscles.

Estimation of DKA, DHA and AA in muscles fatigued through indirect stimulation indicated similar trend (Table II b).

Muscles are known to fatigue on exposure to fatigue fluids[1,8] since the contractile activity is lost. Hence in the present study, fatigue state was induced in the same way and the levels of DKA, DHA and AA were estimated (Table II c). The stimulation was similar. The general trend in the metabolism of ascorbic acid was similar as was found before. Hence it is likely that ascorbic acid is metabolized during the onset of fatigue in muscle whatever may be the mode of fatigue induction.

Since change in the ascorbic acid levels in the environment is known to affect the contractile activity[5] and enzyme activity,[2] it is likely that the onset of muscular fatigue in the muscles has a relation to the ascorbic acid metabolism, probably concerned with activation of ascorbic acid oxidase, and other reduction reactions. To conclude, the onset of fatigue in muscle probably involves the ascorbic acid oxidase activity and other reduction reactions during muscle contraction and as such ascorbic acid metabolism is responsible for the metabolism of fatigue.

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VARIATION OF DEVELOPMENTAL TIME OF *ACARTIA* (COPEPODA) WITH LATITUDE

THE genus *Acartia* is widely distributed in all the seas. About 34 species belonging to 8 subgenera are known. From what is known so far it would appear that the breeding and life-histories vary in different species. *Acartia longiremis* and *A. bifilosa*, which are found in the Gulf of Riga, breed all the year round. In *A. clausi* the first breeding depends on the spring bloom of phytoplankton.

I have been studying the life-history, development and seasonal variations of *Acartia erythrœa*, Giesbrecht, which is found in Porto Novo waters. While comparing my findings with those of other investigators (1 to 5) I found that the duration of development varies in the different species inhabiting different latitude, as shown in Table I.

TABLE I

Species		Latitude	Developmental time in weeks	
			Observed	Calculated
A. clausi	..	62°·00	8·0	8·30
do.	..	50°·15	6·0	5·40
A. tonsa	..	41°·30	3·5	3·20
A. clausi	..	41°·10	3·0	3·16
A. tonsa	..	25°·37	2·0	1·80
A. erythrœa	..	11°·39	1·0	0·95

In *A. tonsa* Woodmansee[5] observed eleven arbitrary peaks in the percentages of adults, in a year, each peak representing a generation. Most of these were at intervals of four weeks or less, with other peaks in between. So the average duration of life-cycle of *A. tonsa* may be taken as about two weeks.

In Graph 1 the log of duration of developmental time in weeks has been plotted against latitude, and a regression line has been fitted by the method of least squares.

Regression analysis shows that there is a close correlation between latitudinal distribution and duration of the life-history. The calculated and observed values for duration of development are in close agreement. The correlation coefficient is (r) 0·973, showing a high degree of relationship. This is interesting as it enables us to find out by extrapolation the duration of development of other species in different latitudes.
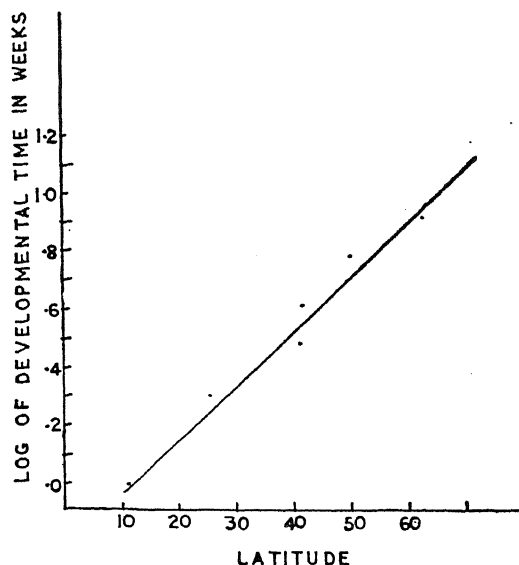
GRAPH 1. Showing the relation between latitude and log of developmental time in weeks.

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AN INDUCED SPHAEROCOCCOID MUTANT IN *TRITICUM DICOCCUM*

Two distinct types of sphaerococcoid mutants, one involving a hemizygous ineffective gene as in the naturally occurring species *Triticum sphærococcum* and the other, a gene with a dominant effect, had been reported earlier in varieties of *Triticum œstivum* ($2n = 42$) treated with mutagens.[1] The latter type of sphaerococcoid occurred only in treatments with ethylmethane-sulphonate (EMS). A mutant similar in phenotype to the EMS-induced sphaerococcoid in *T. œstivum* was isolated by us in 1964 in *T. dicoccum* ($2n = 28$) in the M_2 population derived from a combined treatment with EMS (0·6%) and hydroxylamine (2·5 mg./ml.).[2] This mutant was short, measuring only about 32 cm. in contrast to 89 cm. in the control and had a stiff bayonet-type of flag leaf, hemispherical glumes and spherical grains. Awning was practically suppressed (Fig. 1). There was a

high degree of seed sterility (on an average 3 seeds were obtained in a spike containing 24 spikelets), although pollen fertility was normal. Out of the 10 good seeds obtained from the sphærococcoid mutant, 8 germinated. Four plants in the progeny were normal and the remaining four, sphærococcoid. Thus, this mutant also appears to be of the dominant type, as recorded earlier in EMS-treated *T. œstivum*. Among tetraploid wheats, sphærococcoid mutants have been recorded in *T. durum* by Bozzini[3] in neutron treatments.
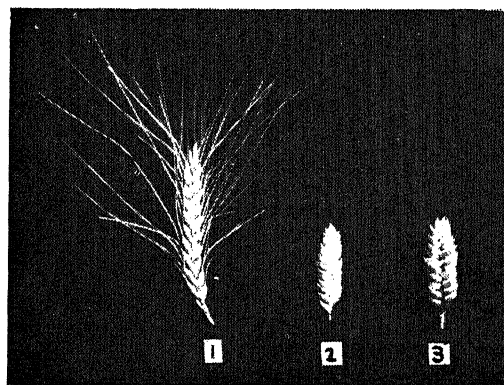
FIG. 1. Ears of (Left to Right) *T. dicoccum*, sphærococcoid mutant of *dicoccum and T. sphærococcum*.

EMS produces a wide range of lethal chlorophyll mutants and viable phenotypic changes in polyploid plants.[4] Mutations with a dominant effect, which are rare in radiation treatments, are induced frequently by chemical mutagens like EMS. The induction of intralocus changes resulting in the origin of genes with an antimorphic effect on function may be a factor involved in this phenomenon.[5] Such functional alterations in the genes may also be responsible for the incidence of a high zygotic sterility not correlated with chromosome aberrations.

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ABSENCE OF MEDULLARY VASCULAR BUNDLES IN *ALTERNANTHERA PARONYCHIOIDES* ST. HILL

PLANTS of the family Amaranthaceæ (including *Alternanthera* Forsk.) generally show the presence of medullary vascular bundles in their stems.[1,2] Their absence has been reported in *Pupalia lappacea* Juss.[3] and *Arthrœrua* Schinz.[4] Vishnu-Mittre[5] reported their absence from the stem of *Alternanthera repens* (Linn.) O. Ktze. Our investigations of the stem of *Alternanthera paronychioides* St. Hill revealed that medullary bundles are completely lacking here.

Amongst the three species of *Alternanthera* that grow in India, *A. sessilis*[6] R.Br. and *A. repens*[5] show eight primary vascular bundles in their apical internodes whereas 14–16 primary vascular bundles are present in *A. paronychioides*. In *A. sessilis,* two bundles situated opposite two externally visible grooves in the stem are nearer the centre, these bundles remain free and later come to occupy a medullary position. The remaining six bundles form a secondary vascular ring. In *A. repens* all the primary vascular bundles are equidistant from the centre in young condition; but in mature stems two regions opposite each other come nearer the centre due to greater development of secondary tissue. In the stem of *A. paronychioides,* however, the primary as well as the secondary vascular tissues remain always equidistant from the centre showing no trace either of the presence of medullary vascular bundles or of locally exaggerated secondary growth (Fig. 1).
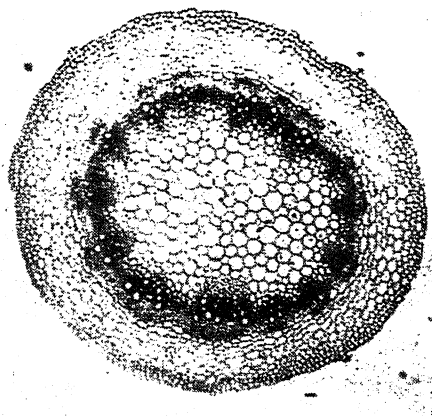
FIG. 1. T.S. of stem of *A. Paronychioides* St. Hill, × *ca.* 33.

As far as we are aware this is the first report of the peculiar anatomy of *A. paronychioides* stem.

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AN *ENTEROBRYUS* (TRICHOMYCETES, ECCRINALES) IN A MILLIPED

A NEW species of the genus *Enterobryus* has been found growing in the hindgut of *Cingalobolus carli* Attems, a common milliped inhabiting the soil where plant debris get accumulated. The hosts harbouring this species have been principally collected in Trichur, Kerala State, at various seasons. About 55% of the hosts were found to be infected with the fungus. The thalli were found to be attached to the hindgut lining which is chitinous in nature. Dissected hindguts were soaked in dilute lactophenol in order to remove the chitinous lining with the thalli. The material was then mounted in lactophenol containing cotton blue.

Enterobryus cingaloboli RAJAGOPALAN, SP. NOV.

Thalli sat arcte spiraliter curvati, curvati præsertim sæpissime ad basin, usque ad 5 mm. longi. Hyphæ flexibus eminentibus ad basin ornatæ, latissimæ ad partem curvam diametientes 15–22 μ, gradatim fastigatæ ad 8–14 μ ad apicem exteriorem. Retinaculum ad 30 μ longum, disco eminenti ad basin ornatum; hyphæ basis angustata ad punctum unionis cum retinaculo; pars angusta ad 10 μ diam.; disco ad 20 μ lato. Sporæ 4-nucleatæ 6–8 × 60–100 μ, hyphis gracillibus insidentes; sporæ multinucleatæ 15–21 × 50–120 μ, insidentes hyphis maioribus.

Thalli fairly tightly coiled, curved predominently in many cases at the base, reaching up to 5 mm. in length. Hyphæ with prominent curves at base, widest in the curved region that measure 15–22 μ, gradually narrowing to 8–14 μ distally. Holdfast up to 30 μ in length with a prominent disc at the base; base of hypha narrowed at the point of attachment to the holdfast; narrow portion up to 10 μ in diam.; disc up to 20 μ wide. 4-nucleate spores 6–8 × 60–100 μ, borne on slender hyphæ; multinucleate spores 15–21 × 50–120 μ, borne on larger hyphæ. Attached to hindgut lining of milliped *Cingalobolus carli* Attems. C. Rajagopalan, Slide TR-1-3, TYPE, in Author's collection.

This species differs from other described species in many details. One feature is the production of both curved, tapering thalli and straight thalli interspersed in the same region of the gut along with very thin filaments producing 4-nucleate spores. The larger hyphæ bear

FIGS. 1–6. *Enterobryus cingaloboli* Rajagopalan, sp. nov. Fig. 1. Distal portion of thalli showing multinucleate spores and the straight growth, × 65. Fig. 2. Holdfast and the curving of the hypha close to the holdfast, × 300. Fig. 3. Much coiled hyphæ, × 400. Fig. 4. Two multinucleate spores, × 400. Fig. 5. A hyaline multinucleate spore produced singly at the distal end of hypha, × 360. Fig. 6. 4-nucleate spores in chain, × 630.

series of terminal multinucleate spores (up to 10) with dense contents obscuring the nuclei. In its general appearance it holds some resemblance to *Enterobryus oxidi* Lichtwardt[1] especially in the curving of the thalli at the base close to the holdfast. But it differs from *E. oxidi* in the nature of the holdfast and the types of spores produced. Similarly in the presence of coiled thalli it has some resemblance to *E. dixidesmi* Lichtwardt[2] but it lacks uninucleate and ellipsoid spores.

Efforts were made to collect specimens of *Cingalobolus carli* at different seasons in order to see whether there is any seasonal variation in the production of different spore types. It was invariably found that the fungus produces only two types of spores—the 4-nucleate and multinucleate types. In a few cases it was noticed that more hyaline multinucleate spores were produced singly and not in chains.

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ENDOSPERM IN THE GENUS *SOPUBIA* HAM.

KRISHNA IYENGAR[5] in his studies on the structure and development of the seed of *Sopubia trifida* observed that the first division of the endosperm mother cell is transverse and it organizes the two primary chambers. The micropylar endosperm chamber soon undergoes a similar division and the young endosperm becomes a linear row of three cells. All three cells divide vertically giving rise to three tiers of two cells each. The chalazal tier develops into a binucleate unicellular chalazal haustorium. The cells of the micropylar tier become binucleate, fuse together and give rise to a 4-nucleate bulbous haustorium which remains in contact with the conducting strand of the seed, while those of the middle tier produce the endosperm proper by further divisions.

The occurrence of a transverse division in the primary micropylar endosperm chamber led Krishna Iyengar[6] to introduce the fourth line of endosperm evolution in the Scrophulariaceæ and accommodate such cases which did not fit into the earlier classification of the endosperm types of the Scrophulariaceæ by Glišic'.[3] Subsequent work on some of those investigated genera, however, revealed the occurrence of a vertical division in the primary micropylar endosperm chamber instead of a transverse one[1,2] and consequently the creation of the fourth endosperm line in the Scrophulariaceæ has been questioned. The present investigation, therefore, was undertaken to check up the sequence of wall formation during the initial development of endosperm of *Sopubia trifida*. The observations presented below are based on the material collected from the hill tops of Kemmangundi, Mysore State.

After the first division of the endosperm mother cell the two superposed endosperm chambers are formed. The next division is vertical in the primary micropylar chamber (Fig. 1). The resulting two juxtaposed cells soon divide transversely giving rise to two tiers of two cells each. The two cells of the upper tier become binucleate and organize the 4-nucleate micropylar haustorium, while those of the lower produce the endosperm proper by further divisions. Meanwhile the primary chalazal chamber usually becomes binucleate by a free nuclear division and functions as the chalazal haustorium.

FIGS. 1-2. Fig. 1. 3-celled endosperm: note the juxtaposed cells derived from the vertical division of the primary micropylar endosperm chamber × 630. Fig. 2. Part of long section of seed to show three of the branches of the micropylar haustorium (indicated by the arrow), × 450.

The later behaviour of the micropylar haustorium in the seed is extremely interesting because the two cells of the haustorium appear

to fuse together and extend toward the chalaza along the conducting strand of the seed in the form of a branched tube, the branches 'rooting' in between the cells of the integument and almost reaching the chalazal haustorium (Fig. 2). The four nuclei move into the haustorial tube and become hypertrophied. Krishna Iyengar[5] appears to have missed this very significant later behaviour of the haustorium.

Our preliminary observation of the endo-sperm development in *Sopubia delphinifolia,* collected near Bangalore, reveals that the division of the primary micropylar endosperm chamber is also vertical instead of transverse.[4] The initial endosperm development in this species is essentially similar to that of *S. trifida.* The earlier reports[4,5] on the occurrence of a transverse division in the primary micropylar endosperm chamber of *Sopubia,* therefore, are apparently incorrect.

We record our thanks to Professor K. N. Narayan for his interest in this investigation and to Mr. D. Ganesh for the photomicrographs.

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A NEW LEAF SPOT DISEASE OF *MUSSAENDA FRONDOSA* LINN.

DURING their survey of leaf spot diseases, the authors observed a severe disease on the leaves of *M. frondosa.* The infection was first noticed in August 1964. Diseased leaves exhibited Prout's brown[1] spots with an outline of tawny[1] colour. The size and shape of the infected area were irregular. The infection either started from the apex of the leaf lamina or from the margins. Occasionally it started from the middle parts of the lamina. The infected lesions were not detached from the healthy lamina till the time of abscission. Isolations from the diseased area gave a highly sporulating culture of *Colletotrichum* sp. In order to satisfy Koch's postulates inoculations were made from the single spore culture of the fungus. It was established that during the rainy season the original symptoms were produced within 4 to

5 days and reisolations always yielded the parent culture. It was thus established that the organism was highly pathogenic. Younger leaves were more easily infected than the older ones.

The inoculations were made at different times of the year and it was noticed that the time needed for the appearance of the symptoms varied considerably. The progress of the disease was very slow during April to June, when the symptoms appeared in 8–10 days. During winter the progress was faster than in summer, but the most rapid spread was evident during the rainy season in August and September. The temperature and humidity play important part in the spread of the disease. The lower surface of the leaves is more susceptible than the upper one.

The identity of the pathogen was confirmed as *Glomerella cingulata* (Stonem.) Spauld. and Schrenk, which is the perfect stage of *Colletotrichum glœosporioides* Penz., from Commonwealth Mycological Institute, Kew, England. A culture of this has been deposited with the C.M.I. as No. IMI 116305, and also in the Botany Department, University of Allahabad, Allahabad.

We are thankful to Dr. J. C. F. Hopkins and Dr. M. B. Ellis for their help in the final identification of the pathogen. We are also thankful to the State C.S.I.R. (U.P.) for awarding a Fellowship to one of us (B. L.).

Allahabad University,   BIHARI LAL.
Department of Botany,   R. N. TANDON.
Allahabad-2 (India), *June 6, 1966.*

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ON *PHAEOTRICHOCONIS CROTALARIAE* OCCURRING ON *MARSILEA QUADRIFOLIATA* IN INDIA*

Marsilea quadrifoliata Linn. (Marsileaceæ) is found growing abundantly in South India along borders of ponds, streams and bunds of paddy fields. During the routine survey for the plant pathogens attacking aquatic weeds in Kerala the author observed the plants affected by a species of *Phœotrichoconis.* A brief account of the fungus is given below :

Spots distinct, purple to rusty brown, amphigenous with a light irregular area in the centre 1–5 mm. in size. Many such spots may often coalesce resulting in a large irregular brown patch. Mycelium thin-walled, septate, light brown, intercellular in the host and 4–6 μ wide. Conidiophores clearly distinguishable from mycelium, arise singly or in clusters from the

stroma, olive-brown, 5–7-celled, basal cells being shorter than the rest, with a bulbose base and a dark prominent scar at the rounded tips and 60–192 × 3·5–4·2 μ in size. Young conidiophores are hyaline, erect or slightly curved. Conidia (porospores) are acropleurogenous, thick-walled, elongate, obclavate to obovate, transversely septate, light to olive-brown in colour, attenuated apically to a simple, occasionally septate, hyaline to sub-hyaline beak, wall constricted at septa mostly in old spores. Isthmus connecting conidia is hyaline. Conidia from host measure 56–108 × 12–20 μ excluding the beak which is 24–176 μ long and have 5–7 septa. Conidia in culture on potato dextrose agar measure 40–92 × 16–20 μ excluding the beak which is 20–184 μ long and have 3–7 septa.
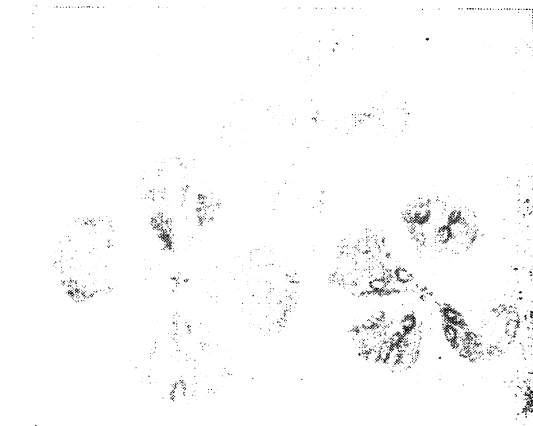
FIG. 1. Leaves of *Marsilea quadrifoliata* showing affected spots.

The fungus collected in May 1963 at Erna-kulam (Kerala) on which the above description is based is deposited in herbarium of Commonwealth Mycological Institute (No. IMI 100880).

The fungus under study was not able to infect *Crotalaria verrucosa* L. nor was *P. crotalariœ* capable of infecting *Marsilea quadrifoliata* L.

The monotypic genus *Phœotrichoconis* was established[2] based on a fungus described under the name *Trichoconis crotalariœ* Salam and Rao[1] as attacking the leaves and pods of *Crotalaria verrucosa* L. On morphological grounds, the author's collection was found to be identical with *P. crotalariœ* (Salam and Rao) Subram. even though it is incapable of infecting *Crotalaria verrucosa*. Comparative dimensions of *P. crotalariœ* and the writer's collection are given in Table I.

TABLE I

	P. crotalariœ on *Marsilea*	*P. crotalariœ* on *Crotalaria*
Mycelium :	4–6 μ	3·6–6 μ
Spore body :	56–108 × 12–20 μ	46·8–96 × 10·4–18·2 μ
Beak :	24–176 μ	49·4–127·5 μ
No. of septa :	5–7	5–8
Conidiophore :	60–192 × 3·5–4·2 μ	52–156 × 3·6–6 μ

So far *Phœotrichoconis crotalariœ* has been known to occur only on *Crotalaria verrucosa*. The writer is here recording the occurrence of the fungus for the first time on *Marsilea quadrifoliata*. The fact that the two fungi are very specific to their respective hosts suggests a possible occurrence of physiological races in the fungus.
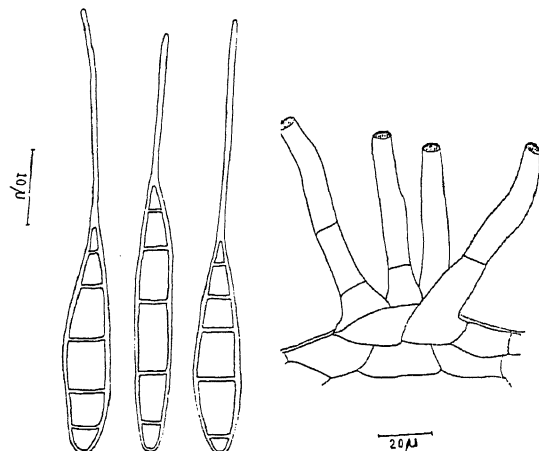
FIG. 2. Conidia and conidiophores of *Phœotrichoconis crotalaria*.

The author is grateful to Dr. V. P. Rao for his keen interest and kind encouragement. He is highly indebted to Dr. M. B. Ellis, Myco-logist, Commonwealth Mycological Institute, England, for identifying the fungus and for useful suggestions.

Commonwealth Institute of   K. M. PONNAPPA.
  Biological Control,
Indian Station,
Post Box No. 1503,
Bangalore-6, India, *August* 10, 1966.

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REVIEWS AND NOTICES OF BOOKS

Whales, Dolphins and Porpoises. Edited by Kenneth S. Norris. (University of California Press, Berkeley and Los Angeles), 1966. Pp. xi + 789. Price 120 *sh.* net.

Until recently most human knowledge of cetaceans was limited almost entirely to the observations and reports of whalers engaged in the chase. However, three factors have so changed this situation that today cetaceans can probably no longer be classed as the world's least known large mammals. First, the whaling industry, which is based upon the maximum, sustained-yield principle, has come to realize that the biology of their prey must become better known if the whaling industry is to survive. Second, public oceanariums have focused both public and scientific attention upon the remarkable attributes of the smaller odontocete cetaceans, such as bottlenose porpoises and pilot whales. As a corollary to this new interest, biologists now find that while they cannot yet handle a full-sized baleen whale in captivity, they can deal directly with a porpoise as an experimental subject. Finally, civilized society has become scientifically minded, and marine mammals have emerged as intriguing subjects from a variety of new and unexpected viewpoints: they obviously hold secrets to underwater communication and navigation beyond the present capability of man; they seem to glide through the water with almost unbelievable ease; and they can live and maneuver in the aquatic world with enviable efficiency. As man's penetration of the ocean depths (which is as great a challenge to him as his invasion of outer space) increases, it is apparent that these significant capacities may become crucial to him in the future.

This book, a representative cross-section of the science of cetology, is the result of a unique meeting of physical scientists and biologists whose research into a wide variety of scientific disciplines, including systematics, fisheries management, zoogeography, natural history, anatomy, physiology, hydrodynamics, acoustics, linguistics, and behavior has brought them to share a common interest in the most recent advances in cetology. The book is based on papers presented at the First International Symposium on Cetacean Research, held in Washington, D.C., which was conducted by the American Institute of Biological Sciences and sponsored by the Biology Branch of U.S. Naval Research.

The text is divided into seven major parts treating, in order, I. Systematics, Distribution, and Natural History; II. Anatomy, Physiology, and Sea-Animal Propulsion; III. Underwater Observation and Recording; IV. Communication; V. Echolocation and Recognition; VI. Practical Problems and VII. Behavior.

The book is beautifully printed and richly illustrated with magnificent figures. These in turn admirably highlight the text and serve to emphasize major experimental findings.

C. V. R.

Bioluminescence in Progress. Edited by Frank H. Johnson and Yata Haneda. (Princeton University Press, Princeton, N.J.), 1966. Pp. xiii + 650. Price $ 15.00.

This book represents the proceedings of the Luminescence Conference sponsored by the Japan Society for the Promotion of Science and by the National Science Foundation, under the United States-Japan Co-operative Science Program, held at Hakone National Park, Kanagawa-ken, Japan, from September 12 to 16, 1965.

The study of bioluminescence—visible light emitted by living organisms—is truly in progress, as the 35 papers making up this volume attest. Not since E. Newton Harvey's *Bioluminescence* was published in 1952 has there appeared under one cover a more comprehensive and critical coverage of the subject. The 48 contributing authors include the majority of the world's leading scientists active in the field today. Essentially every paper contains previously unpublished research results, and some represent real milestones. The approaches to the subject range from the purely chemical and physical (mechanism and kinetics of chemiluminescent reactions in solution) to the more purely biological (anatomical aspects of photogenic organs and the ultrastructure of their component cells). There are magnificent electron micrographs and some color plates among the more than 250 illustrations.

The titles of a few of the most interesting papers contained in this book are: Chemiluminescence and Fluorescence of *Cypridina* Luciferin and of Some New Indole Compounds in Dimethylsulfoxide; The Structure of *Cypridina*

Luciferin ; Activity and Inhibition of *Cypridina* Luciferase : Quantitative Measurement ; Analysis of Inhibition by Urea; and Some Effects of Sodium and Potassium Ions ; Molecular Mechanisms in Bacterial Bioluminescence : On Energy Storage Intermediates and the Role of Aldehyde in the Reaction ; The Luminous Fungi ; Excitation and Luminescence in *Noctiluca miliaris ;* Scintillons : The Biochemistry of Dinoflagellate Bioluminescence ; Bioluminescence Systems of the Peroxidase Type ; Quantitative Measurements of Luminescence ; Firefly Bioluminescence ; Unit Activity in the Firefly Lantern ; Partial Purification and Properties of the *Chœtopterus* Luminescence System ; The Origin of Luciferin in the Luminous Ducts of *Parapriacanthus ransonneti, Pempheris klunzingeri,* and *Apogon ellioti ;* On the Comparative Morphology of Some Luminous Organs, and Observations on Rod-like Contents in the Photogenic Tissue of *Watasenia scintillans* through the Electron Microscope.   C. V. R.

Chemistry and Physics of Carbon (Vol. 2). Edited by Philip L. Walker, Jr. (Marcel Dekker, Inc., New York), 1966. Pp. xiii + 384. Price $ 14.50.

The contents of this volume are as follows : Electron Microscopy of Reactivity Changes near Lattice Defects in Graphite, by G. R. Hennig ; Porous Structure and Adsorption Properties of Active Carbons, by M. M. Bubinin ; Radiation Damage in Graphite, by W. N. Reynolds ; Adsorption from Solution by Graphite Surfaces, by A. C. Zettlemoyer and K. S. Narayan ; Electronic Transport in Pyrolytic Graphite and Boron Alloys of Pyrolytic Graphite, by Claude A. Klein ; Activated Diffusion of Gases in Molecular-Sieve Materials, by P. L. Walker, Jr., L. G. Austin and S. P. Nandi.

C. V. R.

Mathematics and Statistics for Technologists. By H. G. Cuming and C. J. Anson. (Iliffe Books Ltd., Dorset House, Stamford Street, London, S.E. 1), 1966. Pp. 490. Price 105 *sh.*

This book may be described as complete mathematics for practical use in a single volume. It was originally intended to be one of the Heywood *Physical Processes in the Chemical Industry* Series, covering all the mathematical techniques applied in the other volumes. When it became evident that the contents and treatment would command a wider range of readership the publishers decided to bring this out as a separate and individual volume. A perusal

of the book will show that this decision is amply justified. The volume is unique in the sense that each chapter is self-contained and there will practically be no need for the student to look to other sources for further elucidation. The treatment is lucid and the coverage is comprehensive. A large number of worked examples are included.

The following chapter headings will give an idea of the coverage : Review of Elementary Algebra ; Review of Elementary Plane Trigonometry ; Co-ordinate Plane Geometry of the Straight Line, and of the Circle ; Binomial Expansion ; Partial Fractions ; Functions and Limits ; Differentiation, Integration, and Their Applications ; Complex Numbers ; Differential Equations, Ordinary Linear, and Partial ; Statistical Methods, Frequency Diagrams, Probability Theory and its Applications ; Binomial and Poisson Distributions ; Normal Distribution ; Control Charts ; Population and Sample ; Distribution of Differences ; Tests of Significance ; Analysis of Variance ; and Regression and Correlation.

The publication will be specially welcomed by working scientists and technologists who have not specialised in mathematics, but yet have to use mathematical techniques in their work. A less expensive edition would be more welcome.   A. S. G.

Underwater Observation Using Sonar. By D. G. Tucker. [Fishing News (Books) Ltd., Ludgate House, 110, Fleet Street, London, E.C. 4), 1966. Pp. 144. Price £ 2.

Professor Tucker, Head of the Department of Electronic and Electrical Engineering, University of Burmingham, was commissioned by the Buckland Foundation Trustees to deliver the 1966 Buckland Lectures to fishermen on the subject of the use of sonar in fishing activities. The present publication is the outcome of these lectures.

The book explains the problems of underwater observation in general, the importance of sonar (Sound Navigation and Ranging) in this field, and how it works. The treatment throughout is simple, clear, thorough, and quantitative. Thus it will be of practical use to those who are actually concerned with this technique. In addition it will· be equally interesting and informative to the laymen and students. The book is amply illustrated with photographs and line drawings to help understand the textual matter.   A. S. G.

Topological Groups(Second Edition). By L. F. Pontryagin. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Pp. 543; Price $ 32.50 (reference edition); $ 17.50 (professional edition).

The second edition of this Russian text, translated by Arlen Brown, contains a significant number of additions. Some new chapters have been added; thus Chapter 11 gives a classification of Compact Lie Groups; again Chapter 4 on 'Topological division rings and fields' is an addition. This includes a detailed investigation of continuous division rings.

Apart from these additions the emphasis in treatment has been transferred from countably compact and countably locally compact groups satisfying the second axiom of countability, to compact and locally compact groups respectively. This has led to a more up-to-date re-presentation of Chapter 2 on Topological Spaces.   A. S. G.

Techniques and Methods of Polymer Evaluation (Vol. I)—*Thermal Analysis.* Editors: P. E. Slade, Jr. and L. T. Jenkins. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1966. Pp. 253. Price $ 10.75.

Although differential thermal analysis (DTA) has been a well-known analytical technique for some decades by now, it is only recently that this particular technique and its companion, thermogravimetric analysis (TGA) found application to polymer chemistry. The literature on the subject is scattered, and growing. The volume under review presents a comprehensive account of the developments that have taken place in theory and instrumentation of these techniques. It is specially directed to the researcher in polymer chemistry whether in the laboratory or in industry.

The following are the titles and authors of the contributions to this volume: Instrumentation, Techniques and Applications of DTA, by E. M. Barrall, II, and J. F. Johnson; Transition Temperatures by DTA, by D. J. David; Instrumentation, Techniques and Applications of TGA, by H. C. Anderson; Quantitative Calculations in TGA, by C. D. Dolye; and Effluent-Gas Analysis, by A. S. Kenyon.   A. S. G.

Introduction to Nuclear Physics. By Harald A. Enge. (Addison Wesley Publishing Co., Inc., 10–15, Chitty Street, London, W. 1), 1966. Pp. 582. Price $ 3.75.

This introductory text-book on nuclear physics includes nearly all the modern advances in the subject, especially relating to low-energy nuclear physics. A course in atomic physics with wavemechanics is a prerequisite for a full understanding of the topics dealt with in the text.

The treatment includes two-body problems, properties of stable nuclei, nuclear models, nuclear disintegration studies and nuclear interaction studies, elementary particles, and nuclear power. The presentation is such that in each chapter the experimental facts are first set forth, this is followed by development of the theory, and finally experimental results and theory are compared. This impresses upon the student the fundamental fact that physics is an experimental science.   A. S. G.

Books Received

Rothamsted Experimental Station (Report for 1965). (Rothamsted Experimental Station, Harpenden, Herts), 1966. Pp. 375. Price £ 1.00.

Nutrient Minerals in Grassland Herbage. By D. C. Whitehead. (Commonwealth Agricultural Bureaux, Central Sales Branch, Farnham House, Farnham Royal, Bucks), 1966. Pp. 83. Price $ 2.25 or 15 *sh.*

Educational Investigations in Indian Universities (1939-1961). (Chief Publication Officer, National Council of Educational Research and Training, 114, Sunder Nagar, New Delhi), 1966. Pp. 285. Price Rs. 5·00.

A Text-Book of Algebra for Secondary Schools (Part I). By Shanti Narayan and Mohan Lal. (Chief Publication Officer, N.C.E.R.I., 114, Sunder Nagar, New Delhi), 1966. Pp. xv + 312. Rs. 2·75.

Mathematics and Statistics for Technologists. By H. G. Cuming and C. J. Anson. (Iliffe Books, Ltd., Dorse House, Stamford Street, London, S.E. 1), 1966. Pp. 490. Price 105 *sh.*

Proceedings of the Ninth International Conference on Cosmic Rays. Pp.: Vol. I, xi + 605 ; Vol. II, xxiii + 606-1113 ; Price : Both the Volumes—Non-Members £ 10.10 *sh.* ; Members £ 5.00.

THE HUMAN BRAIN *

JACOB CHANDY

Christian Medical College and Hospital, Vellore, Madras

THE brain is confined in the cranial cavity as if in a closed box and its tail or spinal cord extends into the spinal canal. For its protection from injury during the normal movements of the body, the brain and spinal cord are suspended from its covering buffered by a fluid known as the cerebro-spinal fluid.

The brain and spinal cord consist of billions of nerve cells. Anatomists estimate that the brain alone, not including the peripheral nervous system, contains some 10 billion nerve cells or neurons. These in turn are sheathed or supported by some 100 billion glial cells. But the main operative unit is the neuron, the most remarkable of specialised cells. The neurons are further differentiated into 3 broad types—motor neurons, which bring about the contractions of muscles of the entire body ; the sensory neurons which receive and transmit light, heat, pressure and all other sense impulses ; and thirdly, the interconnecting neurons which are the most numerous. The connections to and from each neuron run into thousands producing a network of unsurpassed mystery and complexity.

Each nerve cell has a cell body with its dendrites which form 80% of the neuronal surface, and axons. The axons are the nerve fibres while the dendrites are the dominant part of the receptive surface of the neuron. Each nerve cell gets connected with other nerve cells with dendrites or axons. These connections are called synapses. Some of the synapses have an inhibitory function while the others have an excitatory function. The peripheral axons join together in bundles to form the nerves which supply each and every part of our body. Therefore, the most important fact that we have to recognise is that for the normal working of any tissue in our body, the brain and the spinal cord have an essential part to play. Even the complicated hormones which are produced by various tissues in the body are controlled by the master-gland, the pituitary gland or hypophysis situated in the base of the brain.

Each neuron in maintaining its activity can be compared to a battery because there is a continuous electrical potential gradient in each one of them brought about by the specialised properties of its cell membrane. How the potassium sodium pump of the membrane is maintained and how propagation and maintenance of its activity is continued would be very interesting to a biochemist.

The billions of nerve cells in the brain and spinal cord are arranged in a fascinating manner. The nerve cells are all aggregated together and they are commonly known as the grey matter and the axons or nerve fibres form the white matter in the brain. The intricate network of these axons connecting with its various processes form an integrated whole.

Phylogenetically, the function of the nervous system will fall into various levels. All the newly acquired abilities and talents come at the highest level and interestingly enough the new cells that control such functions are at the cortex or periphery of the brain while the aggregates of neurons cluster themselves into the central part of the brain and manifest functions that are absolutely essential for life.

I want to begin by discussing some aspects of the physiology of perception. Electrophysiological methods are adding fundamentally to our knowledge of the physiological basis of perception. Microelectrodes demonstrate the response to different kinds of sensory stimuli from single neurons at different levels of the nervous system. For some years it has been known that in the retina and optic nerve there are some units which respond to the onset of illumination and some others which respond to its cessation while a different set responds to both. This is known as the "on and off system". Again it has been established that some units respond to movement in one horizontal direction but not to that in the opposite. It has also been shown that even though the visual cortex corresponds to a restricted retinal area, convergence from a considerable retinal field makes itself to a single cortical unit. Also, it is known that the retinal fields have excitory and inhibitory

2

regions. It has been shown that within the receptive field, the summation of various stimuli provide a basis for the specificity of shape, size and orientation. It was further demonstrated that the lateral geniculate body had the same responses and these resembled the retinal configuration more than that of the striate cortex. Thus, it has been shown that perceptual discrimination in vision depends upon physiological organisation in the receptor organ, the retina. And, this in turn upon the anatomical fact that a large number of retinal receptors converge upon a single optic nerve fibre. There is also a spontaneous activity in the sense-organs. The interpretation of these stimuli finally by the cortex is related to learning memory and understanding.

Before considering the more difficult question of human consciousness let us see how the coded information works in simpler brains. The frog's reaction to seeing a fly is to aim its tongue at it. What the coded information derived from the retina of the frog does is to evoke the appropriate action. For this to happen afferent impulses must first convey information about the quality and position in space of the object, which is the fly; and, the frog must also receive information about its own position. In other words, the frog reacts to a fly because of the information processed by its visual system together with that of other information derived from other sources. Even these simple creatures learn by experience. Awareness of the passage of time seems to involve the retention of past experiences against which the ever-changing present is perceived as a novelty until it too becomes the past.

We can hardly consider perception without mentioning memory. But as this is too large a subject, only some aspects of this will be dealt with later. For the maintenance of consciousness the rhinencephalic and diencephalic mechanisms must act with appropriate parts of the cerebral cortex as well as with the upper brain-stem mechanisms. Even a discriminative activity or thought process is not solely a function of the cortex or any single area. Many factors and parts of the brain are concurrently involved.

Let us consider the intricate mechanism of speech. What is it that enables me to speak to you and enables you to translate my words and understand my meaning? I select the words that are symbols of my thought. You receiving these symbols convert them into thought but hold short sequences of my words within the focus of your attention for a fleeting moment long enough for conscious consideration and you add your own interpretation. That is perception of my speech. But an astonishing complex process takes place. A succession of nerve impulses flows out of my brain along the nerves in such a pattern that appropriate muscles contract while others relax, and I speak. An idea has found expression in electrical energy, movement and vibrations in the air. The boundary which separates philosophy from neurophysiology and physics has been crossed. When the sound reaches your ear drums it is again converted into nerve impulses by the receptor organs and are conducted along the auditory nerves into your brain. This stream of nerve impulses results in a secondary mental process in you, that is, again, perception. Thus, mind-brain frontiers have been crossed twice in succession. However, this perception becomes possible in your mind only because of its integrated function, integrating with previous experience, memory and intelligence.

Every intricate activity of the human being is controlled by the brain, spinal cord and nerves through a complicated mechanism that can be described in general terms as cybernetics. All our sensations, movements, actions, behaviour, thought process, memory—in other words, the entire personality of the individual—is through these complicated networks and their functions in the brain and spinal cord.

Comparisons have been made between the human brain and electronic computing machines on at least three different levels—components, coding and logical organisation, and information processing. Attempts have been made to apply these notions to describe and interpret information processing in biological systems. When making such comparisons the brain is viewed as an information-transforming device which accepts data from the external world, interprets and operates on these data and produces control information. In the jargon of the computer engineer the brain is a black box which receives input signals. The receptors from the various sensory organs operate on these signals to generate other output signals which finally go to effectors causing appropriate muscles and glands to function. The information loop is closed *via* the external world and thus the brain is interpreted as a complex,

automatic, regulating device which allows its owner to react so as to maintain a certain stability of success in his interaction with the local environment. Given this interpretation of the brain as a complex computer, attempts have been made to describe the information flow-paths and the logical organisation of its major sub-systems.

There is also the question of memory and how past events are coded and recorded in the brain. Some workers have made estimates as to the total information capacity of the brain. Obviously it varies with individuals thus making one more intelligent than the other. Various types of experiments suggest that a very large proportion of our experiences are coded, recorded and, under certain conditions, subject to recall. Some of these conditions need not be normal or normal function but pathological. Let me give you an example in the form of a case history.

A 26-year old girl had lost her mother at the age of 8. From the age of 18 she would suddenly feel that she was sitting near her mother who was singing a lullaby to put her to sleep. This phenomenon would last for a minute or two. Following this episode she would have some automatic behaviour without her knowledge. Such episodes occurred 5-8 times a year during the next three years. Then she started to get these episodes preceding major convulsive attacks of unconsciousness and convulsions. On investigation, this patient had an activating focus of abnormal electrical discharges in the right anterior temporal lobe. In other words, she started a temporal lobe epilepsy phenomena at the age of 18. When this particular area of the brain was exposed and stimulated by minute electrical currents one could reproduce the same attack which she had been experiencing for 8 years.

Obviously the storage of this experience which she had in her childhood was being brought into activity by the abnormal electrical discharges that were taking place in that specific part of the storage mechanism.

Fixation of experience is a wider topic than learning. It includes changes in the individual system, at all levels from molecule to society, that have become irreversible under single or repeated experiences and so have left some material record of a past activity and it includes racial changes that have cumulated over generations. Behavioural science represents the transient or functional responses of the system to stimuli or stress imposed by the environment and are reversible so that the system essentially reverts after the situations have passed. However, when such stimuli are sufficiently intense or meaningful or repetitive so as to leave an irreversible change, the system undergoes a secular change of fixed experience. The irreversible changes of individual units at the molecular level can include gene mutations and adaptive enzymes. At the cellular level there can occur the whole process of cellular differentiation. At the organ level inductions and gradients and even mechanical forces can mould the particular organ during development. Engrams within the nervous system are entirely comparable residues of experience in the brain. At the individual level come the collective process of aging, perceptual and motor habits, conscious memories and the like. And at the group or social level, cultures create customs, languages and the whole pattern of society. Behavioural attributes can change over many generations. Pressures from an environment will produce evolutionary changes only when the stock is malleable and can respond to pressures. Thus one can inherit not only mutated genes but genes that are more mutable. Adaptive enzymes come into being when both the genetic potentiality and the environmental substrate are present. Thus an organism not only can learn but it can also learn to learn. It is important to realise that even in this process of learning, though a specific area of the brain is central, its relationship with other areas is essential.

The nutrition of every neuron has to be maintained at its optimum for effective function; and, obviously, the nutrition is maintained by the blood supply to the area. Again, the brain is so specialised that there is an effective blood-brain barrier which prevents unnecessary metabolites from adversely affecting the function of the brain. One is familiar with the condition of stroke where one half of the body gets paralysed. What happens to produce such a calamity? The blood supply to one half of the brain might have been jeopardised and thereby that part of the brain cannot function. This illustrates that all activities of the body including motor function, sensations and such other functions are controlled and modulated by the brain. It is important here to emphasize that once a neuron is damaged irreversibly the function of that neuron cannot be taken over by any other neuron nor can that neuron regenerate.

There is a collection of neurons placed longitudinally in the central part of the brain, in the mesencephalon and diencephalon, which is called the reticular formation. The vital importance of this reticular formation of the brain stem has long been recognised. The interference with the function of this region produces respiratory, cardio-vascular, autonomic responses and also can interfere with the state of consciousness. It has been demonstrated that connections from all the known sensory systems enter the central core of the brain stem, the reticular formation, and a multi-synaptic pathway is formed over which impulses are conducted to wide areas of the cortex. In other words the reticular formation becomes the central controlling system for various vital functions and state of consciousness. When we are conscious we are aware of the things around us. The alteration between sleep and wakefulness appears to depend on fluctuations of stimuli, or suppression of stimuli that may affect, the reticular formation. Therefore if there is a lesion in the mesencephalon and diencephalon involving the reticular formation the state which commonly results resembles persistent sleep. It is the continuous bombardment of stimuli from all over the body that maintains the state of consciousness. There is also good reason to believe that cortico-fugal impulses may be capable of damping the reticular formation tending to produce sleep. If the normal waking consciousness depends on a continuously graded upward flow of facilitation from the reticular formation to the cortex and if sleep is manifest at times when that upward flow declines, then we should expect that there would be a continuous cerebral vigilance. We could expect therefore a gradually declining cerebral efficiency as high-grade alertness passes through relaxed indifference, drowsiness and light sleep to deep sleep if this sensory stimulus is withdrawn or dampened by other stimuli. I have touched on a few fundamentally different aspects of brain function. It would be obvious to the thoughtful that for the proper functioning of this gigantic network of neurons in a harmonious fashion, integration of all inputs and outputs will be essential at all levels of the neuraxis and we find that such is the integrated function of the brain.

The recent great discoveries in molecular biology are beginning to give a better understanding of the function of the brain. Science seems to be within reach of understanding not only the physio-chemical workings of the brain and nervous system but also the mysteries of consciousness, memory, learning and all other mental processes. Obviously it could have immense implication for all education and also of mental diseases. No less awesome are the potential dangers of intervening genetically in man's being. This explosive new development has come about when it was found that the total genetic information governing the form and function of every living cell and organism is chemically coded in giant linear molecules of deoxyribonucleic acid or commonly known as DNA. The ribonucleic acid or RNA acts in such a way to mould the thousands of specific proteins making up a particular cell. Different gene sequences are switched on and off in different levels according to a programme laid down in the DNA to form the different specialised tissues. Just as the DNA code determines the colour of the eye, the shape of the nose, the precise functions of such organs as the liver, so also it determines the cast of the mind. The new hypothesis is that DNA not only specifies the physical structure of the brain but it may also control directly or indirectly all brain processes and mental activity through a molecular code. If one can understand this molecular code in the working of DNA, that knowledge can be more devastating than the knowledge of atomic fission.

So far only 2 or 3 suggestive links have been found between DNA and brain activity but enough has emerged to excite in molecular biologists a feeling that this is going to be the next great area of discovery. The period of the study of structural anatomy, showing the connections and pathways and the description of their functions is over. The emphasis placed on the understanding of molecular biology including cell membrane and its functions, the physio-chemistry of the cell itself and the formation of the various molecules are drawing the attention of scientists. Sophisticated instruments including electron microscopes and all such other equipment are now available to help in investigation. So we can look forward to the future for a better understanding of the magnificent organ, the human brain.

THE INDIAN ACADEMY OF SCIENCES : XXXII ANNUAL MEETING

THE Thirty-Second Annual Meeting of the Indian Academy of Sciences was held on the 20th, 21st and 22nd December 1966, at Madurai under the auspices of the Madurai University. The session was inaugurated by Sardar Ujjal Singh, Governor of Madras and Chancellor of the University. Prof. T. P. Meenakshisundaram, Vice-Chancellor of the University, welcomed the large gathering of Fellows, Delegates and the public. Sir C. V. Raman, President of the Academy, delivered the presidential address on "The Eye and Vision" in which he explained some of the significant results that have emerged from his most recent studies on human vision.

Dr. Raman said that one of the most remarkable features of the faculty of vision was that it served one over an enormous range of strength of illumination, but quite differently in bright light and in dim light respectively. It had hitherto been believed that there were two distinct types of vision known as *photopic* and *scotopic*. Functioning at these two different levels of brightness, photopic vision enabled one to perceive both light and colour, and scotopic vision only light but no colour ; while acuity of vision was high in photopic vision and very low in scotopic.

Dr. Raman's investigations have established that in reality there is only one type of vision. It has been proved by him that the fading away of colour and of visual acuity in dim light are both consequences of the corpuscular nature of radiation. It is also found that the spectrum of white light progressively alters in its features with diminishing brightness of luminosity. In bright light the yellow region of spectrum is dominant. But in dim light both the red and the yellow sensations weaken and ultimately disappear. The blue end of the spectrum is but weakly observable in dim light and, at the lowest levels of brightness, it also disappears. Only the green region of the spectrum then persists. This is beautifully demonstrated by observing the sky on a clear moonless night through various colour filters. Through a green filter all the features of the night sky are clearly visible. But through red and blue filters the sky appears very dark, and only a few of the brightest stars can be glimpsed. These facts of observation lead one to conclude that the so-called visual purple present in the human retina, far from playing an active role in the perception of light, is to be regarded only as a physiological exudate which serves to keep the retina with its nervous structures in a state of health.

In the scientific meeting in Section A, on the forenoon of the 21st there was a symposium on "Active Solar Regions" under the Chairmanship of Dr. K. R. Ramanathan. Dr. M. K. Vainu Bappu, Director of the Kodaikanal Solar Observatory, spoke on "Chromospheric Active Regions". This was followed by a talk by Dr. Vikram A. Sarabhai, Chairman of Indian Atomic Energy Commission, on "Active Regions and the Interplanetary Medium". Dr. U. R. Rao, Physical Research Laboratory, Ahmedabad, reviewed the "Recent Advances in Our Knowledge of Interplanetary Space". Dr. K. R. Sivaraman of the Astrophysical Observatory, Kodaikanal, spoke on "The Development of Active Regions on the Sun". Dr. J. C. Bhattacharya and Dr. A. Bhatnagar, also of the Kodaikanal Observatory, presented papers respectively on "Solar Magnetic Fields" and on "Sunspot Velocity Fields".

In the afternoon session of the 21st the following papers were presented and discussed : "High Resolution Studies of Active Solar Regions at Microwave Frequencies" by Dr. Govind Swarup of the Tata Institute of Fundamental Research, Bombay, "Radio Burst Characteristics" by Dr. M. R. Kundu (TIFR), "Composition and Propagation of Solar Cosmic Rays" by Dr. S. Biswas (TIFR) and "Solar Cosmic Rays" by Dr. R. R. Daniel (TIFR). Dr. A. P. Mitra of the National Physical Laboratory, New Delhi, spoke on "Ionospheric Effects of Solar Flares".

Mr. C. Ramaswamy, Director-General of Observatories, Retd., gave a talk on "Monsoons of the World and the General Circulation of the Atmosphere".

In the forenoon session on the 22nd in Section B, Chairman Dr. N. K. Panikkar, Director, National Institute of Oceanography, gave an address on "New Perspective in Brackish-water Biology". This was followed by a talk on brackish-water characteristics by Dr. Qasim (Biological Oceanography Division, NIO, Ernakulam). B. N. Desai and M. Krishnankutty (also of BOD, NIO, Ernakulam) presented a paper on "Studies on the Benthic Fauna of Cochin Backwater".

Prof. S. Krishnaswami (Madurai University) presented some interesting results of work being done by the group in the Zoology Department

Composition and Propagation of Solar Cosmic Rays

S. Biswas
Tata Institute of Fundamental Research
Bombay-5

In this paper the present state of our knowledge on the composition, energy spectra and propagation of solar cosmic rays are briefly reviewed and the relations of these informations to the relative abundances of elements in the solar atmosphere and the structure and configuration of the interplanetary magnetic field are discussed. It is found that the relative compositions of multiply charged nuclei in the solar cosmic rays reflect that of the sun as determined spectroscopically for those nuclei where comparisons can be made. The relative abundances of helium and neon which cannot be determined by spectroscopic means are found to be 107 ± 14 and $0 \cdot 13 \pm 0 \cdot 02$ relative to oxygen respectively. The studies of propagation of low energy solar cosmic rays at solar minimum indicate that the interplanetary magnetic field has a filamentary structure which are twisted and solar cosmic rays are constrained to move along the filaments in well-defined streams. The whole structure retains the basic Archimedes spiral and co-rotates with the sun.

Ionospheric Effect of Solar Flares

A. P. Mitra
National Physical Laboratory, New Delhi

The value of regular recording of ionospheric effects of solar flares in the studies of solar and ionospheric physics are discussed. The principal solar emissions responsible for these effects are the X-rays below 100 A, and the EUV lines, He 304, Fe XV 284 and Fe XVI 335. Almost the entire bottom side ionosphere is affected, conspicuously at heights less than 100 Km, and less obviously, in the E and F regions.

Although the detection capabilities (for H flares) of most SIDs are no more than 30% for flares of Class 2 and above, far short of the capability of centimeter wave radio bursts, their association with X-ray flares and 2800 Mc./s. bursts is well marked. The SID does not occur until the X-ray flux $(\lambda < 10\,\mathrm{A})$ exceeds 2×10^{-3} ergs/cm.^{2}/sec, and unless the quiet day solar radio flux exceeds a threshold value; the time curves of the three types of events are often identical, excepting for a time lag (relative to the time of maximum of the X-ray event) in the SID by a few minutes (4 minutes

for SCNA, 5 minutes for SPA and 10 minutes for SEA); and short-lived X-ray events have clear counterparts in SCNAs.

The transient nature of the X-ray flare provides some unusual opportunities for studying the photochemical processes in the D region. For a complete study, one requires, on one hand, a complete description of all SIDs, and, on the other, X-ray flux variations both in wavelength and in time, for wavelengths below 10 A for the entire period of the event. In the few cases where both information is available, an exhaustive examination in this laboratory has revealed that the electrons are lost in this region mainly through the dissociative recombination with NO^+ with a rate as fast as 1×10^{-7} cm.^{3}/s., and through attachment with O_2 to form negative ions, which are about 10 times as large as the number of electrons at 60 Km. On occasions there is evidence of a substantial lowering of the D region ionisation caused by a hardening of the X-ray spectrum beyond that possible with purely thermal emission. Evidence is also given of small changes at heights above 100 Km. caused by softer X-rays and several strong EUV lines.

Geomagnetic Effects Associated with Active Solar Regions

B. N. Bhargava
Colaba Observatory, Bombay-5

Quiet-sun wind as well as emission of particle and wave radiation from solar flares are described. Terrestrial magnetic and related ionospheric, auroral and cosmic-ray disturbances associated with solar radiation are briefly reviewed. Recurrent magnetic activity during the declining phase of the solar cycle is also briefly discussed.

Velocity Fields in Sunspots

A. Bhatnagar
Kodaikanal Observatory, Kodaikanal-3

Line of sight velocity fields have been obtained using three non-Zeeman sensitive lines: the 4912 NiI, 5576 FeI and 5691 FeI. Velocity field configurations have been obtained during the two successive passages of a single sunspot across the solar disk. Velocities appear systematically larger during the well-developed phase of the spot's life compared to its initial phases. The observed line of sight velocities have been resolved into three mutually perpendicular directions; the radial, tangential and

vertical components. The radial velocity curves show a steep rise and gradual decline in the penumbræ and peter off in the photospheric region. Using Makita's penumbral model a gradient of maximum radial velocity of the order of 4×10^{-3} km./sec./km. in depth, between an optical depth of 0·02 and 0·1, has been obtained. A small vertical component of the order of $-0·3$ km./sec. directed downwards in the penumbral region has been detected. No systematic pattern in the tangential velocity variation has been observed. However, the existence or otherwise of the tangential component of the order of 0·8 km./sec. and less, has not been confirmed.

Asymmetry, in the penumbral lines, has been measured on three disk positions of the sunspot. The asymmetry appears to increase with depth in the sunspot atmosphere. Fluctuations in the continuum brightness and equivalent widths of lines have been observed in the penumbral region. Darker (cooler) regions show widening of lines compared to the brighter (hotter) regions, in the penumbra.

Physiology of Plants under Stress

T. S. SADASIVAN

University Botany Laboratory, Madras-5

Phytopathologists have been intensely interested for many years not only on the cause but also on the effect of a pathogenic condition on host physiology. Abnormal metabolism under pathogenesis has, therefore, been a subject of study in recent years, particularly as it indicates the specific substrate(s) that are involved in the sequence of events that lead to a crippling of normal metabolic processes. Let us take the obligate parasite, viruses, as an example. It is now known that all plant viruses are RNA viruses and that their nucleic acid is the infective part. Virus multiplication represents a derangement of the nucleic acid metabolism of the host cell with effects of a secondary nature on protein metabolism. Even so, the stress for nitrogen at the sub-cellular level in chloroplasts has been clearly demonstrated. It is getting increasingly clear, therefore, that the primary thing is a derangement of the nucleic acid metabolism of the host cell with a side effect on protein metabolism. The discovery of one of the smallest known plant viruses, the satellite virus, which probably cannot multiply on its own and can do so only in the presence of the unrelated tobacco necrosis virus, raises new issues. It probably has to spare few nucleotides after coding for its structural protein and,

therefore, not only fails to multiply unaided but also fails to produce symptoms.

Turning our attention to the rusts and mildews, much is now known to indicate that the enhancement of respiration in infected tissues may be partly due to the nullifying of the Pasteur-effect by a toxin uncoupling respiration from energy-yielding mechanisms of the cell. The basis of this stimulation is that the rate of respiration is governed by the level of tissue phosphate acceptors. Such a situation of interfering with oxidative phosphorylation is also evident in the case of antibiotics such as gramicidin, usnic acid, aureomycin. The normal host cells are geared to an efficient economy and what might be termed a regulated metabolism and any interference in this puts a severe strain on the regulated expenditure of reserves. The invading pathogen is then in a position to obtain some intermediates for its own metabolism.

There are other metabolic events that follow a pathological condition. One such is a change in hormone levels. Hyper- or hypoauxiny is now regarded as a sequel of many metabolic disorders consequent on fundamental tissue changes. This has been ascribed to removal of a growth inhibitor or a direct increase in growth stimulating substance in the invaded tissue. It has been suggested that alteration of the metabolic processes concerned with growth may be a method for successful establishment of obligate parasites. In cases where toxins have been detected and characterized, apart from auxin changes, water relationships of affected tissues have been questioned. A further consequence of these metabolic events is a change in enzymes, such as cytochrome oxidase, peroxidase and polyphenoloxidase. These oxidative changes are largely regarded as defence mechanisms as they bring in their trail chemical entities that may hinder the spread and development of the parasite, one such being the new group of chromanocoumaranes collectively termed phytoalexins. Indeed, the pathways of energy-yielding processes operating in the healthy tissues are in some ways inadequate to couple with the synthetic processes of the parasite.

Some Aspects of Regulatory Mechanisms in the Cell

A. SREENIVASAN

Atomic Energy Establishment, Trombay, Bombay

The multiplicity of functions and patterns in the cell are co-ordinated in a highly organised manner. This is typified by the intracellular

flow of information during the elementary processes of transcription and translation in protein biosynthesis. Superimposed on this are other molecular mechanisms of regulation such as feed-back inhibition, induction and repression.

Illustrative examples of regulation in cellular activity by molecular action and interaction are detailed with reference to experimental data of the author and his associates on stability and changes in the profiles of ribonucleic acids during protein deprivation or thyrotoxicosis in the rat and during phosphate starvation in cells of *Escherichia coli* or *Saccharomyces cerevesiœ*. The functional significance of the increased ribonuclease activity under these conditions and some aspects of adaptive enzyme synthesis are also referred to.

That changes in cell metabolism brought about by physiological or environmental stress states may reside more in altered patterns of enzyme organization rather than in altered enzymes alone, is discussed from the point of view of mitochondrial genesis and turnover. An attempt has been made to aim at a definition of reversibility and irreversibility in cell damage in terms of early metabolic lesions.

Conformation of Polysaccharides

V. S. R. RAO
University of Madras, Madras

The conformation of a polysaccharide depends on the ring conformation of the sugar residue. It is generally accepted that the ring conformation of the sugar residue in the polysaccharide is the same as in monomer unit except in the case of amylose. Some of the results obtained earlier on the conformation of amylose by optical rotation, NMR, X-Ray Diffraction and other chemical methods are reviewed briefly.

The recent results obtained on the conformation of amylose by using the potential energy functions are presented.

Aspects of the Primary Structure of Proteins

L. K. RAMACHANDRAN

University College of Science, Osmania University, Hyderabad-7

Remarkable progress has been made in the determination of the sequence of amino-acids in many proteins during the past two decades. It all started with Sanger's elucidation of the structure of insulin, and today the primary structures of some two dozen proteins are known with certainty. In a few cases, even the variations in structure of a given protein derived from different species are clearly known. The relation between alteration of the structure, by mutation, of a biologically active ribonucleic acid and the alteration in the structure of the protein whose synthesis it directs has become amenable to understanding.

The consequence of these advances has been the impetus given to the chemist to synthesize polypeptides with interesting biological properties. The hypertensins, oxytocin, vasopressin, adrenocorticotropin, insulin, and so on, are now available synthetically. These advances in synthesis, and the development of newer reagents for selective modification of a protein and for its selective break-down are enabling the protein chemist to pursue effectively a cherished goal, namely, to unravel the relation between structure and biological activity. The day may not be far when man shall be able to accomplish in simpler ways the same things which complex biologically active proteins are designed for.

Experimental Manipulation of Chromosomes

T. N. KHOSHOO
National Botanic Gardens, Lucknow

Experimental manipulation of chromosomes, affected in a variety of ways, helps not only to unravel the cytogenetic architecture but also in improvement of a species. Where natural variation is of insufficient interest to a breeder, judicious adjustments made in the chromosomes can help to generate new variability. Not only chromosome parts, but also whole chromosomes or even full genomes of one species can be manipulated into the genetic-cytoplasmic background of another species. Such alien transfers may cause disharmonies of various kinds and degrees by upsetting the intricate balance that exists in genetic system of a species. It is possible to restore the balance under certain conditions.

So far such techniques have been employed in the study of crop plants. The present lecture stresses the need for making such correlated studies of chromosomes and Mendelian heredity in other economic plants.

Studies on the Benthic Fauna of Cochin Backwater

B. N. DESAI AND M. KRISHNANKUTTY
Biological Oceanography Division, National Institute of Oceanography, Ernakulam, S. India

Studies on the macrofauna from five selected stations spread over a distance of about

25 km. in the Cochin backwater showed that the benthic biomass was greater in the regions which were near the sea. The abundance of organisms decreased progressively towards the more estuarine zone. The bivalves, gastropods and polychætes were the most predominant forms in the sample. The presence of larger bivalve, *Meretrix ovum* and the polychæte, *Diopatra neopolitana* at the stations near the sea considerably increased the benthic biomass at these stations. Organisms of lesser importance were crabs, fish, ophiuroids, sea anemones and worms. Studies on meiobenthos which were restricted to estuarine zone only, showed a high degree of abundance of foraminiferans and nematodes. Foraminiferans were more abundant at stations nearer the sea suggesting their preference for marine conditions. The nematodes on the other hand were more dominant at stations away from the sea. An examination of the substrata at five stations showed that the conditions were different from one place to the other. A substratum of fine and coarse sand seems to support a denser benthic population.

The distribution and abundance of macro and meiobenthos compared with the seasonal changes in physico-chemical conditions of the backwater was investigated. It appeared that perhaps the most important factor governing the quantitative distribution of benthos is the salinity. Settling stages of bivalves and gastropods which are of purely marine origin, though appear in large numbers, do not survive in estuarine conditions. Areas of high salinity in the backwater are those which are rich in nutrients and chlorophyll and were found to support a denser benthic population.

Emigration of the Filarial Embryos to Systemic Circulation

V. C. ANGULI
Stanley Medical College, Madras

The infective filarial larvæ penetrate the skin of the sites of mosquito bites and attain sexual maturity in the lymph nodes after their lymphatic sojourn. The adult worms are found in the afferent lymphatics, subscapsular and cortical sinuses of the lymph nodes. The viviparous-embryo worms—microfilariæ are delivered into the afferent lymph space, from where, they get into the venous circulation through the thoracic duct.

Filtration experiments on the lymph nodes show that : (1) Inanimate particles are held up : (2) Red cells are retained and phagocytosed. (3) Bacteria and organisms are filtered. (4) Microfilariæ undergo destruction.

It does not appear possible for the microfilariæ to appear in such large numbers in the peripheral blood after passing through one or more sets of lymph nodes.

Lymphatico-venous shunts are present in 30% of the lymph nodes examined and experimented. This observation with correlated findings suggest this as the pathway of emigration of the filarial embryos to systemic circulation.

On the Monsoons of the World and the General Circulation of the Atmosphere

C. RAMASWAMY

The monsoons of the world can be classified into tropical, sub-tropical, middle-latitude and sub-polar types. Besides these, there is the stratospheric monsoon between 20 and 80 km. above the ground.

The broad zonal character of the monsoonal systems besides their other characteristics have led to a recent concept that the monsoons are essentially due to the thermal response of the continental atmosphere to the annual variation of solar radiation. Indeed, there is a growing mass of evidence to show that the monsoon is a feature of the general circulation itself with world-wide associations.

Considerable amount of research is currently in progress regarding the genesis of the vast anticyclone which develops over the Tibetan plateau and of the easterly jet-stream which builds up over the Asian tropics during the south-west monsoon period and on the interconnection between these two and the south-west monsoon. There is also the burning question whether the millions of tons of water which are released over the Indian peninsula in the form of monsoon-rainfall are brought in from the southern hemisphere across the equator or whether they are provided "locally" by evaporation from the Arabian Sea itself. These and a few other exciting problems will continue to engage the attention of meteorologists as well as specialists in tracer-techniques in the next few years to come.

LETTERS TO THE EDITOR

ESR OF IRRADIATED o-TOLUIDINE HYDROBROMIDE

SINGLE crystals of o-toluidine hydrobromide were irradiated with Co^{60} γ-rays for 18 hours at room temperature so that the total dose is about 20 MR. The ESR absorption from the sample has been studied using a Varian X-band spectrometer with 100 kc./s. modulation. Examination of the spectra in different orientations suggests the presence of the free radical
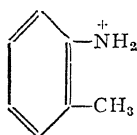
with the unpaired electron localised mostly on the nitrogen atom.

The crystal of o-toluidine hydrobromide belongs to the orthorhombic system and recent X-ray analysis[1] shows that the space group is Pca 2_1 with four molecules per unit cell, the cell dimensions being $a = 16\cdot23$ Å, $b = 5\cdot56$ Å, $c = 9\cdot12$ Å, ESR measurements have been made along different orientations in ab, ac and bc planes at 10° intervals. With the magnetic field along the c-axis, the spectrum obtained was the simplest consisting of nine overlapping hyperfine lines with the intensity distribution $1:1:1:2:2:2:1:1:1$ [see Fig. 1(a)]. Along the b-axis, the spectrum consisted of 12 hyperfine lines with the intensity distribution $1:2:2:1:2:4:4:2:1:2:2:1$ [Fig. 1(b)] and the spectrum obtained along the a-axis was similar except that the central group was not well resolved. The nine-line spectrum (along the c-axis) is due to the hyperfine interaction with two equivalent protons $(I = \frac{1}{2})$ and one N^{14} nucleus $(I = 1)$. The twelve-line spectrum is due to the overlapping of the spectra from radicals occupying magnetically non-equivalent sites showing g-anisotropy. The angular variation of g in ab and ac planes has been studied (see Table I).

The two splitting constants obtained are $45 \pm 1\cdot5$ gauss and $14\cdot5 \pm 1$ gauss (see Table I). The larger splitting has been assigned to the amino-protons from intensity considerations and from a study of partially deuterated sample. The proton splitting is nearly isotropic indicating that the amino group is undergoing rapid rotation at room temperature.
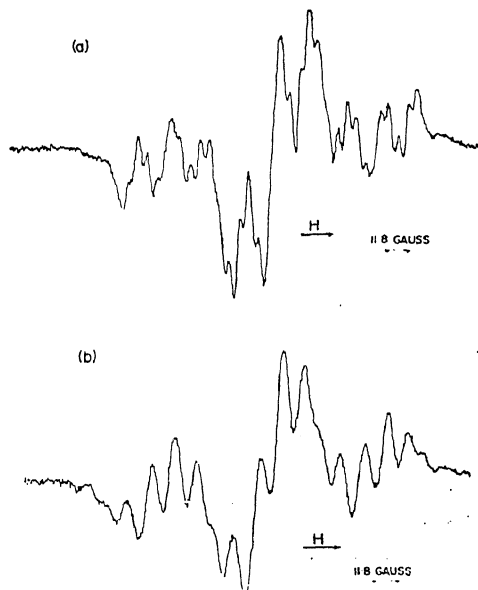
FIG. 1. Derivative of the ESR spectrum of irradiated single crystal of o-toluidine hydrobromide with the magnetic field: (a) along the c-axis and (b) along the b axis.

TABLE I
Summary of the g-values and hyperfine coupling constants for the radical observed in the irradiated o-toluidine hydrobromide

	Tensor elements along the crystal axes	Isotropic value
g	$g_{aa} = 1\cdot9985 \pm \cdot0008$ $g_{bb} = 2\cdot0065 \pm \cdot0008$ $g_{cc} = 2\cdot0036 \pm \cdot0008$	$2\cdot0027 \pm \cdot0008$
A proton	$A_{aa} \simeq A_{bb} \simeq A_{cc}$ $= 45 \pm 1\cdot5$ gauss	$45 \pm 1\cdot5$ gauss
A (N^{14})	$A_{aa} \simeq A_{bb} = 11 \pm 1$ gauss $A_{cc} = 14\cdot5 \pm 1$ gauss	$12\cdot3 \pm 1$ gauss

The observed isotropic proton coupling constant of 45 gauss is large for π-radicals. The ratio $aH/aN^{14} \simeq 3\cdot7$ is also larger than $aH/aN^{14} \simeq 1\cdot1$ observed in the case of planar $\overset{+}{N}H_3$ radical[2] and $1\cdot3$ in the case of $SO_3 - NH_2$ radical[3]. In calculating the proton hyperfine interaction in CH_3 radical, Karplus[4] has shown that the proton coupling constant varies from 23 G for planar configuration to 45 G for tetrahedral configuration. As $\overset{+}{N}H_3$ and CH_3 are isoelectronic, one can explain the large proton

coupling constant as a consequence of the non-planarity of the nitrogen bonds in

$$-\overset{+}{N}H_2$$
$$-CH_3$$
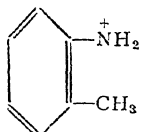
radical. However for the non-planar configuration, the N^{14} splitting is expected to be larger than the observed value of 12·3 gauss.

A preliminary study of irradiated p-toluidine hydrochloride crystals showed that the spectra obtained were essentially the same as the spectra from the o-toluidine hydrobromide. This suggests that the γ-ray damage is confined mainly at the nitrogen site.

The widths of the lines are large, nearly 7–8 gauss, due to unresolved hyperfine structure arising out of the interaction with the ring protons and this structure is partially resolved in the c-axis spectrum.

Further work is in progress and the results will be published later.

The author wishes to express his grateful thanks to Dr. M. R. Das for helpful criticism and to Dr. C. R. Kanekar for constant encouragement. The author is also grateful to Shri V. T. Srinivasan of Biology Division, Atomic Energy Establishment, Trombay, for providing the irradiation facilities.

Tata Institute of   M. V. KRISHNAMURTHY.
  Fundamental Research,
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ZEEMAN EFFECT OF THE NQR SPECTRUM OF p-DICHLOROBENZENE IN THE γ-PHASE

THE purpose of the present note is to report briefly in continuation of the author's earlier work[1] the results obtained of an analysis of the Zeeman effect observations on the Cl^{35} quadrupole resonance spectrum of p-dichlorobenzene maintaining the specimen, in the form of a single crystal in the γ-phase by a suitable adjustment of its temperature.

A single crystal grown from melt is inserted in the r.f. coil of the super-regenerative oscillator and is lowered into a Dewar flask of diameter $2\frac{1}{2}''$. The crystal is first gradually cooled from room temperature to $-70°$ C., as measured by a pentane thermometer by pouring liquid oxygen

into the flask. Then, as the liquid oxygen is allowed to boil away, the sample experiences a slow rise in temperature. As p-dichlorobenzene is known to exist distinctly in the γ-phase over a temperature range of $-30°$ C. to $+5°$ C.,[1] the temperature of the crystal is allowed to gradually increase to about $-30°$ C. The γ-phase signal is now observed. When the temperature rises to $-15°$ C. the intensity of this signal is fine for Zeeman effect measurements. The sample is maintained at this temperature by occasionally replenishing the liquid oxygen in small quantities. The temperature fluctuation is within $\pm 3°$ C.

For taking Zeeman effect measurements the crystal is adjusted to be at the centre of a pair of Helmholtz Zeeman coils capable of orientation about a vertical central axis. A mechanical arrangement has been specially constructed for making low temperature measurements. This is attached to the brass tubing of the r.f. connector. It consists of a rack and pinion arrangement and a system of gears, which enable by an external manipulation a very slow and smooth rotation of the crystal about its axis through any angle over the entire range of 360° without any other disturbing motion.

Observations are taken of the zero-splitting positions for different orientations of the field and the crystal. The analysis is carried out by plotting the zero-splitting locus for the NQR line and refining the locus by the method of least squares. The analysis of the observations on two different specimens has shown that

1. There is only one field gradient as only a single zero-splitting locus is obtained. For β-phase too, only a single field gradient is recorded while there are two for the α-phase.[2–4]

2. The value of the asymmetry parameter η is found to be 0·074. This is of the same order of magnitude as that for α- or β-phase which is $0·06 \pm 0·02$.[4]

Magnetic Resonance Lab.,   B. KANTIMATI.
Physics Department,
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A NOTE ON THE LEVEL STRUCTURE OF Pb²¹⁰

RECENTLY Redlich,[1] from a detailed analysis of the energy level spectrum of Pb²¹⁰ with the use of several types of interactions between the two extra-core neutrons, has found that the Gaussian singlet-even (SE) interaction leads to the best agreement with the experimental data[2] available so far. Weinzierl *et al.*[2] (WUPE) while reporting the measurement of some of the energy levels of this nucleus have also reported some simple shell-model calculations for these levels by using zero-range forces operative only in singlet-spin states. But since our results for the Gaussian SE case with slightly different parameters are a little different from those of references 1 and 2, we should report them briefly as they may be of some interest to the experimentalists.

But first, we write the final expression for the matrix elements of a two-body interaction for the central forces, which we need for evaluating the various shell-model states of Pb²¹⁰

$$\langle j_1 j_2 : JM \mid H_{12} \mid j_1' j_2' : JM \rangle = \sum_{\substack{LL'S \\ N\lambda nln'}} A \begin{pmatrix} l_1 & s_1 & j_1 \\ l_2 & s_2 & j_2 \\ L & S & J \end{pmatrix} A \begin{pmatrix} l_1' & s_1' & j_1' \\ l_2' & s_2' & j_2' \\ L & S & J \end{pmatrix}$$

$$B_{N\lambda nl}^{n_1 l_1 n_2 l_2} (L) \, B_{N\lambda n'l}^{n_1' l_1' n_2' l_2'} (L') \, S_{LL'} \, \langle nl, S \mid H_{12} \mid n'l, S \rangle.$$

Here A( ) are the 9-*j* symbols and B's are the transformation brackets. Further, in these calculations, we neglect the roles played by configuration interaction and fix the potential strength parameter from the observed spacing of the 2⁺ and 0⁺ levels of the ground-state configuration and the single particle energies from the data on Pb.²⁰⁹ Thus here, we fix our parameters from the experimental splitting of the lowest two levels in comparison to Redlich who uses SE Gaussian effective interaction with parameters determined from low-energy proton-proton scattering data.

Table I lists our levels for the best fit with Gaussian SE interaction for the choice of

parameters $V_o = -40$ MeV and $\lambda = (r_o/\sqrt{2} \; r_i)$ $= 0.74$ in comparison to Redlich's values of $V_o = -31.6$ MeV and $\lambda = 0.80$. This table clearly shows that our low-lying 6⁺ level is in much better agreement with the experimental value and on the basis of our general agreement between the calculated and observed values, we suggest the 8⁺ state to be near 1.224 MeV. The levels due to the configuration $(1 \, i_{11/2})^2$ come out in MeV's to be 1.390 (0⁺), 2.012 (2⁺), 2.530 (4⁺), 2.696 (6⁺), 2.788 (8⁺) and 2.860 (10⁺). Here also we find that our 4⁺ level at 2.530 MeV corresponds more correctly to the probable 4⁺ experimental level at 2.40 MeV in comparison to WUPE and Redlich's values at 2.581 and 2.596 MeVs respectively. But the close agreement between these values of WUPE and Redlich might lead one to think that the experimental state at 2.58 MeV could be a 4⁺ state. The major difference in the excited levels due to the $(2 g_{9/2} \, 3 \, d_{5/2})$ configuration and the odd-spin levels of the $(2 g_{9/2} \, 1 \, i_{11/2})$ configuration worked out by us and those by WUPE is that our levels are not coming out to be degenerate as those predicted by them. While the comparison of our levels with those of Redlich for the configurations $(2 g_{9/2} \, 1 \, i_{11/2})$ and $(2 g_{9/2} \, d_{5/2})$ shows that our levels are somewhat raised up though the ordering is the same. Only in a few cases the cross-over of the levels takes place and that is shown in Table II.

TABLE II

Comparison showing the cross-over of levels. Values are in MeV.

Configuration	Redlich[1]	This work
$(2_{g9/2} 1_{i11/2})$	2⁺(1.964)), 4⁺(1.966)	4⁺(2.165), 2⁺(2.180)
	9⁺(2.983)), 7⁺(1.993)	7⁺(2.102), 9⁺(2.117)
$(2_{g9/2} \, 3_{d5/2})$	6⁺(2.564)), 3⁺(2.694)	3⁺(2.828), 6⁺(2.852)

Our levels for these configurations may also be made to fit with those of Redlich in case we either reduce the potential strength or the range parameter. But our low-lying levels for the $(2 g_{9/2})^2$ and $(1 i_{11/2})^2$ configurations do not permit us to do so. It would thus be interesting to have more experimental information on this nucleus since it would help us in computing these parameters and in deciding about the operating effective two-body nuclear interaction.

TABLE I

Experimental (*) and calculated (**) energy levels of Pb²¹⁰ for the configuration $(2 g_{9/2})^2$. Values are in MeV

Authors J	0⁺	2⁺	4⁺	6⁺	8⁺
Weinzierl *et al.*[2] (*)	G.S.	0.795	1.09	1.17	..
Redlich[1] (**)	,,	0.802	1.041	1.123	1.153
Weinzierl *et al.*[2] (**)	,,	0.795	1.090	1.220	1.252
This work (**)	.. ,,	0.795	1.087	1.192	1.224

Panjab Agricultural Univ., GIAN AGGARWAL.
Palampur (Kangra),
and
University of Adelaide, VIJAY KUMAR.
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CIS-STABILISATION OF *o*-CHLOROPHENOL AND *o*-CHLOROANILINE

THE presence of intramolecular hydrogen bonds in *ortho*-disubstituted benzene derivatives[1] and the consequent stabilisation of *cis*-molecules have been postulated on the basis of studies dealing with physical properties of pure *ortho*, *meta* and *para*-substituted chlorophenols and chloroanilines. In the course of studies on thermodynamic properties of binary liquid mixtures, the author noticed that volume change on mixing in the mixture, *o*-chlorophenol-dioxan, differs appreciably from that in *p*-chlorophenol-dioxan mixture. A similar difference in the values of volume change on mixing was observed between the binary mixtures of dioxan with *o*-chloroaniline and *m*-chloroaniline. The observed differences in volume change on mixing provide evidence for the presence of intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline, which stabilise the cis-isomers. The values of fluidity difference $(\triangle \phi)$ calculated using Bingham relation[2] also support the contention that intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline stabilise *cis*-molecules.

Volume change on mixing was calculated from precision density values of pure liquids and liquid mixtures obtained by Pycnometric method at $35 \cdot 0° \pm 0 \cdot 01°$ C. as described earlier.[3] Fluidity difference was evaluated from viscosities of pure liquids and liquid mixtures measured with the use of an Ostwald viscometer at $35 \cdot 0°$ C.

Volume changes on mixing and fluidity differences of equimolar mixtures of the four systems studied are given in Table I.

TABLE I

Mixture		V^{M} ml./mole	$\triangle \phi$ Centipoise^{-1}
o-Chlorophenol-dioxan	..	$-1 \cdot 35$	$-0 \cdot 375$
p-Chlorophenol-dioxan	..	$-0 \cdot 59$	$-0 \cdot 304$
o-Chloroaniline-dioxan	..	$-0 \cdot 72$	$-0 \cdot 229$
m-Chloroaniline-dioxan	..	$-0 \cdot 65$	$-0 \cdot 224$

The observed values of volume change on mixing and fluidity difference are made up of three contributions : (*a*) a positive one due to break up of polymers of the phenols and the anilines, (*b*) a positive change due to rupture of intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline and (*c*) a negative one due to hydrogen bond association between the phenols and the anilines with the diluent, dioxan. The net volume change on mixing (negative) and fluidity difference (negative) show a strong tendency for hydrogen bond association between the solute and solvent in all the four mixtures. The difference in the values of volume change in mixing and fluidity difference in *o*-chlorophenol-dioxan and *p*-chlorophenol-dioxan is attributable to the presence of intramolecular hydrogen bond in *o*-chlorophenol which stabilises the *cis*-molecules, cis-stabilisation leading to a relatively large concentration of *cis, o*-chlorophenol molecules. The chloroaniline-dioxan systems follow the same pattern, as is to be expected the *cis*-stabilisation is more strongly evident in chlorophenol than in *o*-chloroaniline.

Chemistry Department, P. R. NAIDU.
S.V. University,
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HISTAMINE RELEASING EFFECTS OF A FEW INDIAN MEDICINAL PLANTS USED IN BRONCHIAL ASTHMA

Solanum xanthocarpum and *Clerodendron serratum* have been popular Ayurvedic remedies for the treatment of bronchial asthma.[1] A gluco-alkaloid isolated from the berries of *S. xanthocarpum* and a crystalline polyhydric alcoholic fraction isolated from the roots of *C. serratum* have been found to cause a delayed secondary fall in blood pressure accompanied with broncho-constriction which was inhibited by pretreatment with the antihistaminic drugs.[4,5] After repeating the doses the hypotensive and broncho-constrictor response of both drugs, as well as that of compound 48/80 recorded as per technique of Konzett and Rossler,[5] was found to diminish significantly though response to histamine was not found to be altered.

Further the anaphylactic broncho-constrictor response in sensitised isolated guineapig lung was found to be inhibited after continuous

perfusion of the crystalline fraction of *C. serratum,* which *per se* caused diminution in outflow associated with the release of histamine as deducted in the perfusate. Both the drugs in 0.4×10^{-4} concentration caused release of histamine from chopped pieces of guineapig lung incubated as per technique of Mongar and Sehild.[7]

In another experiment, daily administration of 2 mg./kg. intraperitoneal doses of the gluco-alkaloid and the alcoholic fractions of the drugs for two weeks in guineapigs sensitized with egg albumin caused 66.6–70.2% protection on exposure to micro-ærosol of the antigen which was found to be fatal to 80% of the control guineapigs. Histamine content of the tissues of lung, abdominal skin and stomach after extracting with 10% trichloroacetic acid as per technique of Parratt and West[8] was estimated biologically on atropinised guineapig ileum as shown in Table I.

TABLE I

Treatment	Average histamine content μg./g. of tissues		
	Lung	Skin	Stomach
Control ..	10.61±2.42	34.40±2.21	23.40± 6.48
C. serratum	2.40±0.91	42.70±4.63	28.81± 9.42
S. xantho-carpum	1.68±0.68	37.51±3.50	29.91±10.51

From the data, it would be observed that marked depletion of histamine from lung tissues occurred after chronic treatment with the drugs as compared to the untreated controls injected distilled water only. This decrease of histamine in lung was found to be associated with increase in skin and stomach, similar to that observed after administration of the gluco-corticoids.[2,9] Since the anti-allergic action of the gluco-corticoids has been partly attributed to the depletion of histamine in tissues,[2] it is likely that protection observed in the treated group of sensitised guineapig exposed to the antigen (egg albumin) micro-ærosols may also be related to the specific depletion of histamine from bronchial and lung tissues. The refractoriness of the bronchial tissue to the specific allergans and compound 48/80 seem to be similar to that reported by Macintosh and Paton[6] for the area of skin which has been the site for wheal produced by histamine liberator causing depletion of the local stores.

Department of Pharmacology,   S. S. Gupta.
Gandhi Medical College,   Mahesh Rai.
Bhopal (M.P.),   N. K. Gupta.
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CHEMICAL INVESTIGATION OF THE ROOT BARK OF *TILIACORA RACEMOSA* 'COLEBR.'

THE isolation of three new quaternary alkaloids has been reported[1,2] from the root bark of *Cissampelos pareira* 'Linn.' (Menispermaceæ), one of which showed promising curare-type activity. It was considered of interest to investigate other species of this family for alkaloids which might possess physiological activity and we, therefore, undertook the investigation of the root bark of *Tiliacora racemosa* 'Colebr.' (Hindi—Begum ushada ; Bengali—Tiliakoru). This plant grows widely in Assam, Bengal and Uttar Pradesh and its bitter roots are reported[3] to be useful in snakebite and scorpion sting. Its leaves and bark are reported to contain poisonous alkaloids.[4]

Roots of *T. racemosa,* collected from the suburb of Lucknow, U.P., were dried, powdered and exhaustively extracted with 50% aqueous alcohol to which 3% acetic acid was added. The combined extracts were concentrated to a small volume under reduced pressure. The concentrate was basified with ammonia when mixture of bases was precipitated in the form of a brown viscous mass. The choloroform extraction of the decanted aqueous layer gave further quantity of the bases.

The base mixture showed the presence of six alkaloids by T.L.C. with cotton pad at the top on Kieselgel G[5] using the solvent system : Chloroform-methanol (9 : 1) and spraying with Dragendorff's reagent for visualisation.[6] One of the alkaloids was identical with tiliacorine[7] reported to be present in this plant.

From the mixture of alkaloids a new base could be isolated in a crystalline form, m.p. 306–08° C., on the basis of its lower solubility

TABLE I

Properties of the isolated alkaloids

Substance	Isolated as	Solvent of crystallisation	Formula	$[\alpha]_D$	m.p. °C.	Found percentage				Calculated percentage			
						C	H	N	Halogen	C	H	N	Halogen
A	Iodide	Me-AcoEt	$C_{19}H_{24}O_3NI$	−18 (Me)	211–14	51·40	5·40	3·20	28·80	51·69	5·48	3·17	28·77
B	,,	Alc	$C_{20}H_{26}O_5NI$	−10·6 (Me)	156–59	49·54	5·61	2·65	26·77	49·26	5·38	2·87	26·04
	Perchlorate	Cy	$C_{20}H_{26}O_9NCl$	−70 (An)	147–50	52·20	5·62	2·70	6·85	52·24	5·69	3·04	7·71
D	,,	Me-W	$C_{20}H_{24}O_8NCl$	+122 (Py)	256	53·90	5·10	3·20	8·30	54·34	5·47	3·17	8·02
	Iodide	Me	$C_{20}H_{24}O_4NI$	..	242–44	51·00	5·34	2·85	..	51·16	5·15	2·98	..
Base (new)	..	Me-Chf	$C_{17}H_{14}NO_5.2H_2O$	+196 (Py)	306–8	59·06	5·06	4·05	..	58·56	5·20	4·02	..
Methiodide of base	..	,,	$C_{19}H_{19}O_5NI$	+72 (Py)	283	48·85	4·46	2·95	27·23	48·82	4·08	2·99	27·11

Abbreviation.— Me=Methanol;   Py=Pyridine;   An=Acetone;   AcoEt=Ethyl acetate;   Alc = Ethanol ; Cy=Cyclohexane; Chf=Chloroform; W=Water.

in chloroform. It was considered to be pure through T.L.C. and was characterised as its methiodide.

The ammoniacal aqueous solution after separating the bases was acidified with dilute hydrochloric acid to pH 2 and the water-soluble bases were precipitated as Reineckates.[8] Treatment of the acetone-soluble Reineckates with silver sulphate and barium chloride[9] yielded a mixture of quaternary alkaloids as their chlorides. This mixture on paper chromatography (System : Methylethyl ketone : ether (5 : 1)/1% aqueous hydrochloric acid) revealed six Dragendorff positive spots, named as substances α, A, B, C, D and E whose R_{csm} values are 2·61, 1·70, 0·75, 0·51, 0·26 and 0·14 respectively taking cissamine chloride[2] as the reference. The R_f value could not be determined as proper resolution of the mixture occurred after six hours when the solvent front had run out of the paper.

For the separation of these quaternary alkaloids the chloride mixture was chromatographed over a cellulose column[10] and eluted with the solvent mentioned earlier for paper chromatography. Chromatographically pure substances A, B and D were thus obtained but could not be crystallised as their chlorides. They were, therefore, characterised as their crystalline iodides or perchlorates obtained from the chlorides in the usual way. Characteristics of the new alkaloids are summarised in Table I.

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Department of Chemistry,   T. K. PALIT.
Lucknow University,   A. C. ROY.
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SYNTHESIS OF 4-AMINOMETHYL CARBOSTYRIL DERIVATIVES

CHUDGAR AND TRIVEDI[1] conclusively proved that bromination of acetoacetanilide gave *w*-bromo acetoacetanilide which on cyclisation gave 4-bromomethyl carbostyril. These 4-bromo-methyl carbostyril derivatives are now used as intermediates for the synthesis of 4-amino-methyl carbostyril derivatives.

4-Aminomethyl carbostyrils are prepared by refluxing equimolecular quantities of dimethyl-

amine, piperidine and morpholine respectively with 4-bromomethyl carbostyrils, dissolved in alcohol, for 2 to 3 hrs. The separated 4-aminomethyl carbostyril derivatives (Table I) are filtered, dried and recrystallised from alcohol or benzene.

TABLE I

4-Dimethylaminomethyl Carbostyril

Sl. No.	Substituents in carbostyril	m.p. °C.	Molecular formula	Found % N	Required % N
1	None	197	$C_{12}H_{14}N_2O$	14·4	13·88
2	8-Methyl	199	$C_{13}H_{16}N_2O$	12·63	12·96
3	6-Methoxy	183	$C_{13}H_{16}N_2O_2$	12·33	12·07
4	6-Chloro	230–32	$C_{13}H_{13}N_2ClO$	11·89	11·85
5	6-Bromo	230	$C_{12}H_{13}N_2BrO$	10·22	9·964
6	7-Chloro	183	$C_{12}H_{13}N_2ClO$	11·73	11·85

4-Piperidinomethyl Carbostyril

1	None	209	$C_{15}H_{18}N_2O$	11·99	11·57
2	8-Methyl	232–33	$C_{16}H_{20}N_2O$	11·05	10·94
3	6-Methoxy	221–23	$C_{16}H_{20}N_2O_2$	10·17	10·30
4	6-Chloro	245	$C_{15}H_{17}N_2ClO$	10·23	10·13
5	6-Bromo	242	$C_{15}H_{17}N_2BrO$	8·41	8·616
6	7-Chloro	239	$C_{15}H_{17}N_2ClO$	10·33	10·13

4-Morpholinomethyl Carbostyril

1	None	235	$C_{14}H_{16}N_2O_2$	11·43	11·48
2	8-Methyl	240–41	$C_{15}H_{18}N_2O_2$	11·13	10·85
3	6-Methoxy	208	$C_{15}H_{18}N_2O_3$	10·21	10·22
4	6-Chloro	240–42	$C_{14}H_{15}N_2ClO_2$	9·96	10·06
5	6-Bromo	230	$C_{14}H_{15}N_2BrO_2$	8·382	8·67
6	7-Chloro	234	$C_{14}H_{15}N_2ClO_2$	10·48	10·06

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Chemistry Department,   R. J. CHUDGAR.
Faculty of Science,   K. N. TRIVEDI.
M.S. University of Baroda,
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BIOSYNTHESIS OF ASCORBIC ACID IN HUMAN PLACENTA *

INTRODUCTION

PREVIOUS studies in this laboratory suggested a negative balance between dietary intake and milk secretion of vitamin C in lactating women.[1] Women at the end of six months of lactation performance were found to compare with women at the start of lactation in vitamin C status as judged by urinary excretion, blood content of the vitamin and response to test doses of the vitamin. These findings were confirmed by longitudinal studies on pregnant and lactating women for a period of 10 months beginning from the last trimester of pregnancy (Rajalakshmi, Subbulakshmi and Kothari, unpublished). Since a prolonged negative balance with regard to vitamin C was not accompanied by deficiency symptoms even at the end of lactation the hypothesis of vitamin C synthesis in the human body either normally or adaptively has to be considered. Such a hypothesis has been suggested by Bagchi[2] who notes the absence of scurvy during pregnancy and lactation in poor Indian women. Jelliffe[3] has noted the total absence of infantile scurvy in the tropics and subtropics although the diets are poor in vitamin C. Other authors such as Davidson and Passmore[4] and Mitchell[5] have not ruled out synthesis of the vitamin in the human body.

EXPERIMENTAL

If the hypothesis of synthesis, at any rate during pregnancy and/or lactation, is accepted, the placenta, the mammary glands and the liver must be examined as possible sites of such synthesis. The placenta offered itself as the most suitable candidate because of its being a concentrated source of several nutrients and its relatively easy availability. This communication reports enzymatic synthesis of ascorbic acid by human placenta tissue from *D. glucuronolactone.*

The human placenta was transferred to a polythene bag immediately after delivery and brought to the laboratory under ice. It was cut into small pieces, the blood removed by blotting with filter-paper and the tissue ground in a mortar kept in ice with three volumes of cold sucrose solution (0·88 M) for 5 minutes. The homogenate was filtered through cheese cloth and used. All the operations were carried out at 0–1° C.

The assay system for enzyme assay as well as the method used for the estimation of ascorbic acid formed were the same as those of Chatterjee *et al.*[6,7] except that the pH of the phosphate buffer used was 7·5 instead of 7·0.

RESULTS AND DISCUSSION

The effect of pH on the ascorbic acid synthesis is given in Table I from which it is found that the optimum pH for ascorbic acid synthesis in human placenta is 7·5. Table II gives the data on the effect of omission of different components of the enzyme assay from which it is found that the synthesis depends on substrate, enzyme and buffer but not on KCN. It is interesting to note that in the present case KCN is not required

whereas Chatterjee *et al.*[7] have reported its requirement for synthesis in rat liver.

TABLE I

Effect of pH on ascorbic acid synthesis in human placenta

pH	Ascorbic acid formed μ moles $\times 10^{-2}$
5·7	2
6·0	5
6·5	7
7·0	13
7·5	18
8·0	9

TABLE II

Enzymic synthesis of ascorbic acid in human placenta

System	Ascorbic acid formed in 2 hours (μ moles)
Complete system ..	0·30
—Enzyme ..	0·04
—Substrate ..	0·10
—Buffer ..	0·11
—KCN ..	0·45
Complete system with TCA added before incubation	0·12

In order to confirm the product formed as ascorbic acid an experiment was conducted in which the assay system contained 10 times the components used for normal assay and was incubated for 2 hours. TCA was added before incubation in the blank whereas it was added after incubation in the experimental. After incubation the contents of both experimental and blank were freeze-dried in a lypholizer and taken in 0·5 ml. of glass-distilled water. A known amount of the same (0·02 ml.) was spotted in Whatman No. 1 filter-paper of size 18″ × 22″ along with standard vitamin C solution and a descending chromatographic run was carried our for 16 hours using *n*-butanol : glacial acetic acid : water (80 : 20 : 20) as the solvent. The chromatographic paper was dried in air at room temperature and sprayed with 2, 6-dichloro-phenol indophenol (0·4% in absolute ethanol). Pink spots appeared both in the experimental and blank corresponding to that of ascorbic acid in the standard but the experimental produced a much bigger spot than the blank.

Though the above observations confirm the synthesis of ascorbic acid in human placenta, only 27 out of 40 cases examined were found to show synthesis. Samples which showed activity were found to have a characteristic pink colour. The samples were found to lose their activity within 4 hours of storage in the deep freeze suggesting the rapid lability of the

enzyme which is perhaps responsible for failure to detect activity in the other cases. It is also possible that the synthesis depends on dietary factors, particularly the adequacy of the diet with reference to vitamin C and the availability of cofactors required for the synthesis. Studies are now in progress on women differing in dietary status to identify the conditions which determine synthesis.

The results will be subjected to verification using labelled intermediates as substrates. Until such confirmation is obtained, they must be considered as tentative.

Depts. of Foods and   R. RAJALAKSHMI.
   Nutrition and Biochem.   G. SUBBULAKSHMI.
M.S. University,   C. V. RAMAKRISHNAN.
Baroda (India),
      and
Depts. of Gynæcology   S. K. JOSHI.
   and Obstetrics,   R. V. BHATT.
Medical College,
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MICROGRAPHIC TEXTURE IN A CHARNOCKITE DYKE OF HEBBALE, COORG DISTRICT, MYSORE STATE

A CHARNOCKITE dyke is exposed on the eastern bank of the river Cauvery (N. 12° 31′ 29″; E. 75° 58′ 27″) at S. 63° E. of Hebbale and N. 12° W. of Shanbhoganahalli. The dyke strikes along N. 35° E. with a width of about 75′ amidst weathered gneisses and can be traced for about half a furlong. A careful observation reveals characteristic variation in the granularity of the dyke. Along the margins it is finegrained, while towards the centre the texture becomes coarser.

Study of thin sections of the dyke rock showed sub-ophitic texture, and a detailed

examination, especially, of the thin sections of the central portions revealed micrographic intergrowth between plagioclase and quartz in isolated patches (Fig. 1). Such a micrographic intergrowth between the plagioclase feldspar and quartz, appears to be a rather rare feature.[1-3]
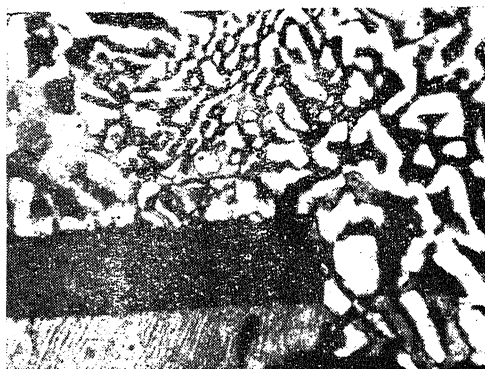
FIG. 1. Portion of Charnockite exhibiting micrographic texture between plagioclase (twinned) and quartz. Plagioclase (grey) and intergrown quartz (white). Crossed nicols, × 70.

Mineralogically the dyke is composed of clouded plagioclase feldspar, hypersthene and diopsidic augite. Hornblende, biotite mica and magnetite occur as secondary minerals after the primary mafic minerals.

The feldspar is optically biaxial positive with $a + 2V = 72°–88°$. The anorthite content of 30–40% indicates the feldspar to be Andesine. The twin laws of the feldspar were determined on the 4-Axes Fedorov's Universal Stage and out of 15 grains examined, 6 exhibited complex Manebach-Acline = Ala, 4 Manebach-Ala = Acline, 2 Albite-Ala-B, 2 Albite and 1 Manebach laws.

The laths of plagioclase feldspar contain intergrowths of quartz in the form of small, but nearly triangular blebs, fine rods and filaments or threads. The triangular blebs, which are confined mostly to the central portion of the feldspar lath are, in all probability, due to the cleavage control. The presence of two straight edges of the bleb may be an indirect evidence to show that, these directions are nothing but the traces of mutually perpendicular cleavages. The third side of the triangular bleb is irregular, as it happens to be the diagonally ruptured side of cleaved block, and appears to be due to the force of the invading residual silica solution.

The fine rods and filaments of quartz which are displayed prominently along the cleavage directions and the composition planes of the host feldspar indicate that the silica solution has acted along certain planes of feldspar which are highly susceptible for solution action. The replacement seems to have occurred first along the marginal cleavages, and later along the twin lamellæ, and finally along and across the composition planes of the feldspar (Fig. 2).

FIG. 2. Pegs and blebs of quartz (white) appearing across the composition plane of twinned plagioclase (grey and black). Crossed nicols, × 150.

The bigger relict patches of individual feldspar laths though dissected into pieces by the intergrown quartz, still exhibit contiguous twin lamellæ as well as optical continuity. Similarly the composition plane can also be traced though it has been cut across by the intergrown quartz.

It is also observed that the contact between the feldspar and the intergrown quartz is not a sharp one throughout. The presence of sharp contact at places, and hazy contacts elsewhere, may be cited as examples of complete and partial replacement respectively, depending upon the conditions favouring or otherwise the process of replacement.

Thus, it may be summed up that the cleavages and characteristic twinning of the plagioclase feldspar have jointly acted as a solid framework of mould for the casting of silica in the form of graphic intergrowth.

Based on the above description, it is evident that the graphic intergrowth seen in the Hebbal dyke is a case of replacement of plagioclase by silica. The amount and extent of replacement of plagioclase appear to have been controlled by environmental conditions like temperature, and pressure; presence of cleavages, twin-lamellæ, and other susceptible margins; and above all by the concentration of silica solution.

Incidentally, it may be pointed out that the graphic texture, under description, is confined to the central portion of the dyke, which was

the last to solidify and wherein the volatiles had concentrated. Thus, it becomes clear that the texture is post-magmatic, and appears to be mostly pneumatolytic, when hot residual silica-bearing solutions acted upon and partially replaced the newly crystallised feldspar laths, ultimately producing the intergrowth texture.

Thus the present study is yet one more instance, though rare, to show that quartz undeniably replaced plagioclase feldspar in order to produce the micrographic texture.

The authors are thankful to Professor M. N. Viswanathiah for his encouragement, and the junior author is grateful to the Council of Scientific and Industrial Research, New Delhi, for the award of a research fellowship.

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Mysore-6, *June* 22, 1966.

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WELTRICHIA SINGHII n. sp. FROM THE RAJMAHAL HILLS, BIHAR

Amongst the plant fossils collected from Sakrigalighat, Rajmahal Hills, Bihar, the author has recently found an interesting specimen of a bennettitalean male 'flower'. The specimen is in counterparts and is preserved as a cast. It is attached to a Bucklandia-type of stem (Fig. 1). The stem is 4·5 cm. long and 5·8 cm. broad. One of the counterparts consists of the decorticated portion of the stem showing a large number of oval or eye-shaped depressions of leaf-bases (as seen from inside). The other counterpart shows the woody portion (B). At the apical region of the stem a small partially expanded 'flower' is seen directly attached to it. The 'flower' consists of a basal cup about 1·5 cm. deep and 2 cm. in diameter at the point of attachment and 3·3 cm. in diameter from where the free ends of the microsporophylls arise. The microsporophylls (S) are badly preserved, closely set and some at places overlapping each other. The exact number of microsporophylls is rather difficult to determine but seems to be about 12. Microsporophylls are tough and coriaceous with much wrinkled surface. In dorsal view microsporophylls are oval in shape. Only in one microsporophyll finger-like appendages (PA), somewhat like those of *Williamsonia santalensis* Sitholey and

Bose,[1] are clearly visible. These are supposed to be the pollen-bearing organs but no pollen has been recovered from any one of them.
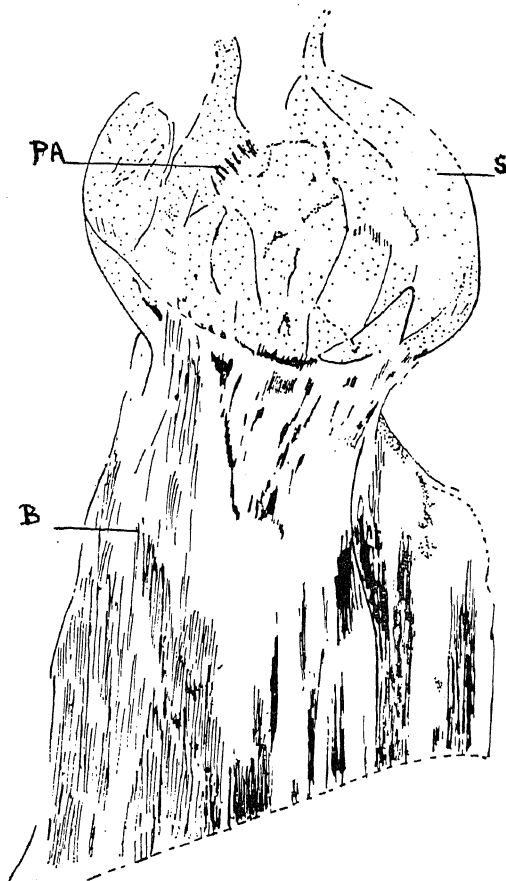
FIG. 1. *Weltrichia singhii* n. sp. B.S.I.P. No. 26952, ×1.

Generally, such whorls of bennettitalean microsporophylls are described under the genus *Williamsonia* which was instituted by Carruthers[2] in 1870. However, Braun[3] had already described a whorl of microsporophylls under the generic name *Weltrichia* and should be applied to the present specimen and as well as other bennettitalean male 'flowers' which resemble the microsporophylls of *Weltrichia*. Because of this fact it is suggested that the original specimens of *Williamsonia santalensis* Sitholey and Bose[1] should also be included under the genus *Weltrichia*. *W. singhii* differs from *W. santalensis* in being very small in size and in having fewer number (only 12) of microsporophylls. In *W. santalensis* the number of microsporophylls are supposed to be 20. *W. mirabilis* Braun[2] too has about 20 microsporophylls.

The specific name has been given after Dr. Gurdip Singh of Birbal Sahni Institute of Palæobotany, who collected the specimen.

The author is thankful to Dr. R. N. Lakhanpal for kindly going through the manuscript.

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PLANT TYPE AND HARVEST INDEX IN *RAGI* (*ELEUSINE CORACANA* GAERTN.)

THE importance of plant type for high productivity has been demonstrated in crops like paddy and wheat. Its importance in *ragi* improvement work cannot be ignored. Plant type is also related to harvest index. A suitable plant type with a higher harvest index has to be evolved. Harvest index is the grain weight expressed as a percentage of the total dry weight of the plant cut above the ground level. This is usually very low and is in the range of about 20-30%. This index, however, is very much subject to environmental control. This means that with the available varieties, only about one-fourth of the dry matter synthesized is in the from of grain, while three-fourths of the dry matter is in the form of the comparatively less valuable straw. This assumes special significance in *ragi*, where while the grain is very nutritive, the straw is known to be of indifferent fodder value. It would then be particularly desirable to increase the value of the harvest index in *ragi*. This aspect of amelioration of the *ragi* crop had been receiving active attention in the Division of Botany during the past three years and the encouraging results obtained are presented in this note.

As tall plants tend to increase straw weight, plants of medium height, or short plants or even dwarf plants will have to be preferred. Large number of primary or basal tillers would also tend to lower the harvest index and hence cannot be considered a desirable character. Large number of secondary or nodal tillers would also have a similar effect. However, a few (2-4) fruiting branches arising right near the top may add to the grain yield significantly without proportionate increase in straw weight. Leaves with upright habit increase the effective area of the leaf and are conducive to increased yields and hence are to be preferred. Also a large duration of head filling would help to increase the grain weight as compared to straw weight. The plant body should be compact so that a larger than usual population can be effectively raised in unit area. With these objectives in view, single plant selections were made in the World Germ-plasm collection of *ragi*. These were tested in preliminary row trials with suitable checks. The more promising of these were put in a small-scale replicated trial at Delhi during *Kharif* 1965. The data are presented in Table I. Selection 2 has a very desirable plant type; it has 2-4 synchronised tillers, compact habit, rather erect leaves and a long duration of head-filling, a high plant

TABLE I

Performance of ragi selections during Kharif 1965

Selection No.	Description of Plant type	Per plant yield of		Percentage increase over test check	Harvest index
		Grain (gm.) (Average of about 80–110 plant from two replications)	Fodder (gm.)		
Sel. 2	Normal height; 2-4 basal tillers; a few nodal tillers right at the top harvesting to be done two times	19·0	43·0	(46·2)	30·7
Sel. 1	Medium height, 2-4 basal tillers, synchronised tillering mid-late maturity; shortened peduncle	17·1	37·6	(31·6)	31·3
Sel. 3	Dwarf; 2-4 basal tillers; profuse nodal tillering; harvesting to be done 2-3 times	14·2	28·1	(9·2)	33·6
Sel. 4	do.	13·3	32·5	(2·3)	29·0
T. 36 (Control)	Short; 2-4 basal tillers; profuse nodal tillering harvesting to be done twice	13·0	31·7	··	29·1
V.R. 7 (Control)	Medium height; 2-4 basal tillers; nodal tillering present; harvesting to be done twice	11·6	30·3	··	27·7
Purna (Control)	do.	10·8	35·6	··	23·3
Co. 7 (Control)	do.	8·8	5·7	··	13·4

yield (31·5% more than the best check) and a comparatively high harvest index. Selection 1, also has a desirable plant type; it has 2–4 synchronised tillers, but also develops near the top, a few nodal tillers which mature a little later, thus making a second picking necessary. This has given the highest per plant yield (46·15% more than best check). This has a comparatively high harvest index. Because of their compact habit, a larger than normal population of these selections can be accommodated in unit area, thereby increasing the yields.

Selections 3 and 4, are dwarfs, but have profuse nodal tillering which is not a very desirable feature. However, they have comparatively a high harvest index and a high per plant yield. This indication of a shift towards grain production in these selections will favourably affect grain yields, while fodder yields may be adversely affected. To some extent, this decrease in fodder yield may be made up by larger populations per unit area. However, a net decrease in fodder yield may result, but will be more than compensated by the increased grain yield. Actually this may lead to the farmers taking to a better and more nutritive fodder crop in such areas. These selections are being tested in large-scale trials at different locations within the country to confirm their superiority.

The authors are grateful to Dr. M. S. Swaminathan for encouragement and valuable suggestions.

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OCCURRENCE OF ZEBRA-NECROSIS IN *SORGHUM*

DURING the study of Sorghum World Collection, consisting of 4027 stocks from 44 countries, grouped into 70 tentative groups[5] grown at this Institute in 1965-66, a particular type of zebra-stripping, resembling closely that in maize (Giesbrecht[2] and Horovitz[4]) was observed for the first time. It was identified by the presence of longitudinal chlorotic bands, alternated with normal green tissues of similar length across the width of the leaves (Fig. 2) and sometimes in the marginal region also. In most of the cases the length of the bands was normally 4 to 12 cm. with a maximum of

26 cm. (Fig. 3). The maximum number of bands per leaf was observed to be 8 or 9, while in most of the cases it was usually 2 or 3 confined to the distal half of leaf-blade.

The chlorotic bands gradually became more and more prominent, followed by necrosis, which ultimately led to the rapid drying of the leaves. The necrosis spreads only in the chlorophyll-deficient bands in longitudinal direction (Figs. 1 and 3).
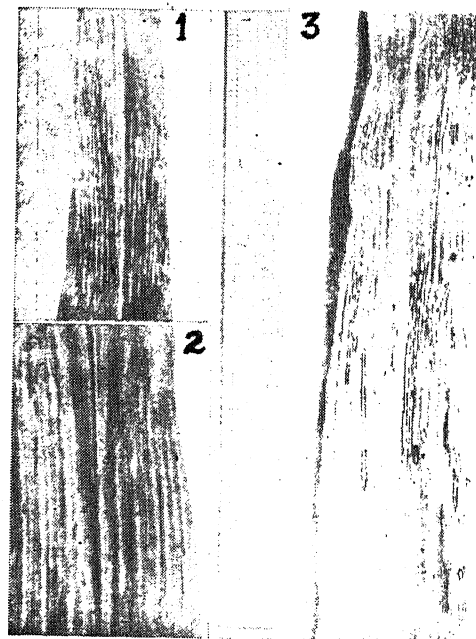
FIGS. 1–3. Fig. 1. Development of necrosis at later stage. Fig. 2. Development of Zebra-stripping. Fig. 3. Maximum length of a necrotic band.

Out of 4027 stocks only 88 lines (2·2%) exhibited zebra-stripping. Among these affected lines 62 (about 70·0%) were from South and Eastern African regions, thereby indicating that the alleles for this character are prevalent in these areas, which are supposed to be the centre of origin and differentiation of cultivated sorghums.

Fungal and bacterial pathogens were ruled out after microscopic examination. Since the disease was not sap-transmissible and the young leaves were unaffected, the virus as a cause of necrosis was unlikely. It is, therefore, non-pathogenic necrosis, controlled by some genetic mechanism.

The observations clearly demonstrate that the necrosis was least frequent (less than 5% of the population) in the species, excepting Sudanense (8·33%) and Nigricans (7·0%). It was most frequent (more than 5% of the popu-

lation) in the hybrid complexes of the Caudatum with Durra, Bicolor, Kafir, Nigricans and Guineense and the Nigricans with Bicolor and Feterita which would indicate a complementary genetic system governing this character, as was observed in *Gossypium*,[1] *Triticum*[3] and *Oryza*.[6] Such a system could have been of great significance in the species differentiation of the genus *Sorghum*, since such mechanism could act as a barrier to free gene-exchange and promote the process of incipient speciation in this genus where crossability barriers are poorly developed.

Our sincere thanks are due to Dr. B. R. Murty for his keen interest in this study.

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Indian Agri. Res. Institute, M. B. L. SAXENA.
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RECORD OF A TACHINID PARASITE, *ALSOMYIA ANOMALA* VILLEN, ON *SESAMIA INFERENS* WLK.

DURING the course of field observations in April 1965 on the pink borer of sugarcane, *Sesamia inferens* Wlk., a few caterpillars were found rather sluggish and inactive. These were kept under regular observation in the laboratory. After about a week, a species of maggots emerged from the bodies of these larvæ—one maggot from each larva. The maggots entered pupation soon after. The flies, which emerged 7-8 days after pupation, were identified as *Alsomyia anomala* Villen (Tachinidæ) by the Commonwealth Institute of Entomology, London. This is probably the first record of occurrence of this parasite on *S. inferens*, in India. It has earlier been observed parasitising the paddy and sugarcane skipper, *Pelopidas mathias* F., Fam. *Hesperiidæ*, in Java (Box, 1953).

Our thanks are due to the Director, Commonwealth Institute of Entomology, London, for kindly identifying the parasite specimens.

Indian Institute of   A. N. KALRA.
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Lucknow, *July* 14, 1966.

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ASCORBIC ACID CONTENT OF SOME FRESHWATER FISHES OF BHAVANISAGAR RESERVOIR

THE ascorbic acid content of fishes has been reported by earlier workers. Love[5] and Love, Lovern and Jones[6] have furnished data on the ascorbic acid content of many species of fish. Ambuja Bai and Kalyani reported on the ascorbic acid content of the skin and muscle[1] of six species, and that of liver, kidney, brain and blood[2] of three species. Foreman[4] found that the ascorbic acid content of the ovary varied with the estrous cycle. Fontaine[3] studied the ascorbic acid content in the pituitary of salmon. We report here the result of our work on the ascorbic acid content of seven freshwater fishes of Bhavanisagar Reservoir.

Fresh fish, as soon as they were landed from the Reservoir, were taken up for the experiments. A composite sample of the muscle was taken and ground, and a weighed amount extracted for determination of ascorbic acid according to the method of Roe (Glick, 1950).[7] Gonads and liver were similarly handled. As regards the pituitary, the entire gland was used and the ascorbic acid is expressed in mg. per gland. Mean values and range of ascorbic acid are given in Table I. *Labeo fimbriatus* showed the highest values for AA-6·255 mg.% for the muscle. It is seen that all the freshwater fishes listed by Love *et al.*[6] except *Corogonus* sp. and *Hemibarbus barbus* had lower ascorbic acid than the fishes enumerated in this report.

With regard to the gonads, in *Macrones aor*, high values were noted but no seasonal or maturity-based variations could be indicated with the present data alone. The gonads of *Labeo fimbriatus* also had fairly high ascorbic acid, ranging from 3·498 to 6·95 mg./100 g. A comparison with Love *et al.*[6] shows very high ascorbic acid values for the gonads of freshwater fishes like *Abramis vimba*, *Carassius auratus*, *Cyprinus carpio*, *Hemibarbus barbus*, *Ophiocephalus tedianus*, etc. The male gonad was supposed to be poorer than roe in vitamin C. It appears to be true in the case of *Macrones aor*. *Wallago attu* testes, however, had the highest ascorbic acid content, 13·7 mg%. The crocodile testes had the lowest ascorbic acid content. Generally, the liver contained more ascorbic acid than the muscle, except in *Wallago attu* and *Labeo calbasu*. The liper ascorbic acid of *Macrones aor* was higher than that of the fishes studied by Ambuja Bai and Kalyani.[2] The ascorbic acid in the kidney (0·952) and heart (0·606) of the crocodile was lower than that of freshwater fishes cited by Love *et al.*[6]

TABLE I
Ascorbic acid content of some freshwater fishes

Name of fish (Number of samples)		Weight range Kg.	Ascorbic acid mg./100 g. (Mean and ranges)			Mg./ gland pituitary
			Muscle	Gonad	Liver	
Macrones aor (8)	..	1·0-3·75	1·545 (0·525-3·642)	4·173 (1·164- 9·568)	4·173 (0·622-7·92)	0·272* (0·04 -0·446)
Barbus dubius (6)	..	1·5-3·50	1·434 (0·564-2·553)	1·726 (1·007- 2·975)	2·272 (0·870-4·433)	0·126 (0·022-0·249)
Labeo fimbriatus (4)	..	2·0-5·0	3·369 (0·79 -6·255)	4·833 (3·498- 6·95)	2·396 (1·900-2·580)	0·103 (0·02 -0·238)
Wallago attu (2)	..	2·0-3·75	2·225 (1·880-2·571)	9·290 (4·879-13·700)	3·493 (2·115-4·170)	0·028 (0·023-0·033)
Labeo calbasu (1)	..	3·0	0·930	2·130	3·210	0·020
Catla catla (1)	..	2·0	1·440	2·750	4·540	0·030
Crocodile (1)	..	200·0	2·836	0·696	3·134	..

* In terms of percentage, the AA content of one of the glands was 2·35 mg./100 mg. gland.

and Ambuja Bai and Kalyani.[2] Pituitary glands of *Macrones aor* and *Barbus dubius* had higher ascorbic acid than that of other three fishes studied. A decrease occurs in the ascorbic acid content of the pituitary of *M. aor* from February through March to June, i.e., post-spawning period. Fontaine[3] noted that in salmon, the ascorbic acid in pituitary gland decreases with the maturity of the fish.

Our thanks are due to Prof. R. V. Seshaiya for his suggestions.

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Bhavanisagar P.O., S. India,   N. SABHAPATHY.
June 27, 1966.

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RECORD OF *APOLLODOTUS PRAEFECTUS* DISTANT (HETEROPTERA: MIRIDAE), PREDACIOUS ON *STEPHANITIS TYPICUS* DISTANT (HETEROPTERA: TINGIDAE), A PEST OF COCONUT PALM

MATHEN[3] described the life-history and pest habits of *Stephanitis typicus* D. on coconut foliage. Shanta *et al.*[4] reported on its additional role as a carrier of the pathogenic principle, perhaps a virus, involved in the root (wilt)

disease of coconut, a challenging threat to its cultivation in Kerala. Since then, investigations on the various aspects of the pest like seasonal abundance, vector-virus relationship and control engaged greater attention of research workers at this research station. An interesting observation was the occurrence in the field of nymphs and adults of a Mirid bug in association with populations of *Stephanitis typicus* D. This has been identified[1] as *Apollodotus praefectus* Distant. In its record from Pusa (Lefroy) and Ceylon (Green), no description is available on its habitat. Hoffmann made mention about a Mirid bug observed attacking these lace bugs on banana in Nanning.[2] Probably it is the same or nearly related. Preliminary observations on coconut seedlings at this research station by the authors showed that the swift-moving, milk-white predatory nymphs were available in large numbers between the post-north-east and pre-south-west monsoon months of December to May. In the laboratory, under caged conditions, the nymphs were feeding well on nymphs of all stages of the pest at the rate of one to seventeen host nymphs per predator nymph per day. The nymphs were also observed to suck adult lace bugs. The authors are grateful to Dr. M. G. Ramdas Menon, Indian Agricultural Research Institute, New Delhi, for identification of the insect.

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Central Coconut Research   B. SATHIAMMA.
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EMBRYOLOGICAL STUDIES IN *TRICHODESMA ZEYLANICUM* R. Br.

THE family Boraginaceæ has attracted the attention of embryologists because of the diversity in the endosperm development and variations in embryogeny. *Trichodesma zeylanicum* belongs to the tribe Cynoglossæ of Boraginaceæ. The present note deals with sporogeneses, development of gametophytes, endosperm and embryo in *Trichodesma zeylanicum*.

A young anther consists of a rounded mass of meristematic cells. It soon becomes four-lobed. A hypodermal archesporium differentiates in each lobe as a plate of four to five cells (Fig. 1). Subsequent periclinal divisions in the hypodermal archesporium result in the formation of an outer parietal and an inner sporogenous layer (Fig. 2). The sporogenous layer by further divisions produces a massive sporogenous tissue while the parietal layer divides to form a three-layered anther wall, the innermost of which becomes the tapetum. The hypodermal layer in the anther wall is transformed into fibrous endothecium. The middle layer degenerates early (Fig. 5). The tapetal cells become multinucleate in later stages (Fig. 3). The epidermal cells are heavily cutinized along their outer tangential walls. The sporogenous cells become rounded up and undergo meiosis to produce isobilateral, tetrahedral and decussate tetrads of microspores (Fig. 4). The microspores are triporate and show a smooth exine. Pollen grains are shed at two-celled stage (Fig. 5).

A remarkable feature observed in the present study is the occurrence of some enlarged multinucleate and vacuolated cells below the sporogenous tissue (Fig. 2). These cells get differentiated during the division of the primary archesporium and undergo precocious nuclear divisions and become multinucleate. They resemble the tapetal cells at a later stage and persist during microsporogenesis, and appear to take part in the nutrition of the microsporocytes before the differentiation of the tapetum, finally degenerating along with the tapetal cells.

The ovary is superior, bicarpellary and syncarpous, later becomes four-loculed due to the development of a false septum. The ovular primordia develop as blunt outgrowths from the axile placenta and give rise to semi-anatropous, tenuinucellar ovules with a massive integument. The hypodermal archesporium is usually single-celled (Fig. 6), but occasionally two to four archesporial cells are also differentiated. The archesporial initial directly functions as the megasporocyte (Fig. 7) which after meiosis produces a T-shaped tetrad of megaspores (Fig. 8). The chalazal megaspore divides further to produce an eight-nucleate embryo-sac of Polygonum type (Figs. 9, 10). A mature embryo-sac shows a pair of pear-shaped synergids and a rounded egg that constitute the egg apparatus. The antipodals organise as definite cells. The polar nuclei remain without fusion for a long time.

Fertilization is porogamous. The endosperm is free nuclear and of the Borago type. The primary endosperm nucleus undergoes many free nuclear divisions which are synchronous (Figs. 11, 12). The embryo development conforms to the Asterad type (Figs. 12–14). The first division of the zygote is transverse leading to the formation of a basal cell *cb* and a terminal cell *ca* (Fig. 12). The pro-embryonal tetrad is T-shaped (Fig. 13). Cell *ca* contributes to the development of embryo proper while the cell *cb* gives rise to the hypocotyl, hypophysis and a short suspensor.
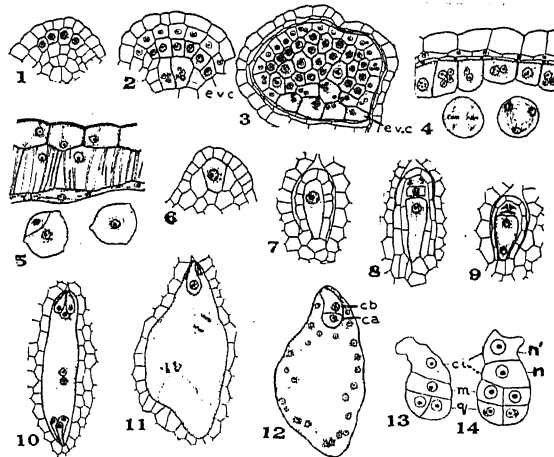
FIGS. 1–14. Figs. 1, 2, 4, 5, 6, 7, 8, 13 and 14, × 242. Figs. 3, 10 and 12, × 121. Fig. 9, × 194. Fig. 11, × 86. (*e.v.c.*, enlarged vacuolated cells.)

Department of Botany,   TASNEEM FATHIMA.
Central College,
Bangalore University,
Bangalore, *July* 23, 1966.

REVIEWS AND NOTICES OF BOOKS

Cell Synchrony—*Studies in Biosynthetic Regulation.* Edited by Ivan L. Cameron and George M. Padilla. (Academic Press, New York and London), 1966. Pp. xv + 392. Price $ 15.00.

Cell synchrony has become an important experimental approach for the amplification of cellular events. This book is a compendium of research approaches in the field of cellular growth and replication. It presents a broad coverage of many cell systems—from fungi and bacteria to mammalian cells. Each of the eighteen chapters deals comprehensively with a separate cell system in which regulatory processes are investigated by the techniques of cell division synchrony. The material will help the reader understand the evolutionary diversity between different types of cells. It will also provide a basis for classifying regulatory processes which operate in different cell types and in the same cell under different synchrony procedures. This book will be of value to students and workers in cell biology, zoology, biochemistry, microbiology cytology, developmental biology, general physiology, and biophysics.

C. V. R.

Progress in Experimental Personality Research (Vol. 2). Edited by A. Maher. (Academic Press, New York and London), 1966. Pp. x + 331. Price $ 9.50.

This series provides a summary of recent developments in the study of personality. Contributions range from hitherto unpublished works in important areas to syntheses of data and to integrated summaries of present knowledge.

The second volume of this serial publication presents contributions covering the effects of birth order on the development of personality, interpersonal behavior, audience sensitivity, problems raised by Kelly's psychology of personality constructs, and cognitive complexity.

Successive volumes will continue to report contributions resulting predominantly from work in the laboratory (including the animal laboratory) when they are directed at questions which have significant and clear implications for the study of personality. Activities from the field will also be included. These volumes provide an opportunity for the reader to keep abreast of current developments in personality research.

C. V. R.

Proceedings of the Symposium on Bacterial Transformation and Bacteriocinogeny, August 13-16, 1963. (*Symposia Biologica Hungarica 6*). (Akademiai Kiado, Budapest), 1966. Pp. 167. Price $ 6.00.

This work contains the lectures, debates and contributions to the Symposium organized by the Hungarian Academy of Sciences.

The volume contains also literary references and consists of three parts. Part 1 deals with the transformation of bacteria, Part 2 with the phenomena of bacteriocinogeny, and Part 3 with the genetic fundamentals of cell regulation.

C. V. R.

Die Saugetiere Der Sowjetunion : Band I (Paarhurfer und Unpaarhufer). (VEB Gastav Fischer, Verlag, DDR—Jena, Villengang 2/ Postschlieb fach 176). Pp. 939. Price Geb. MDN 163.20.

This edition of the *Mammals of the Soviet Union* describes in all details more than 300 species of this vast kingdom, including those which habitate the seas and oceans surrounding the territories of the Soviet Union.

In recent years Soviet scientists have carried out intensive research with the scope of collecting all relevant material, mainly however regarding the biology of all the species. This research also covered the entire territory of the Soviet Union. The results, though constituting thousands of publications in the USSR, have unfortunately remained almost unknown elsewhere. Thus the purpose of this edition (in German) is to present a summary of all these results to a wider interested circle.

The characteristics of the groups (order, family, species) are given universally but the stress is on the description of the species according to a strict principle synonyms classification, information on the habitation, size, weight, etc., of the mammal and assessment of its position in the complete system. The geographic distribution of the mammals is described in detail and also, in a series of cases, the historical changes. The geographic variations are also illustrated by means of figures. These figures

have been checked and cross-checked for this edition.

A larger space is taken up by the description of the biology of the species under the following chapters: numbers, living conditions, food, region where found, habitation, activities during the course of 24 hours, sleeping and hybernation, yearly wanderings, reproduction, growth and development, hair growth, enemies, sickness, mortality, parasites, competitors, locomotion, field characteristics. A special chapter is devoted to the practical significance of the species and their protection. Sketches on a few species, for which detailed information is available, represent a sort of systematic-ecological monography.

Some historical extinct animals like the wild horse (tarpan), the wild camel and sea-cows are also described.

The excellent pictures, photographs, pencil sketches and paintings by the best Russian animal painters as well as the maps showing geographic distribution deserve special attention.

The entire collective work will comprise 4 to 5 volumes. The different types of mammals are treated in the different volumes. The first volume deals with cloven-hoofed and unclovenhoofed animals. It contains 268 text-figures and 6 colour plates. Each volume contains an index and an extensive bibliography.

Since many of the mammals living in the Soviet Union are spread out far beyond the Soviet frontiers, covering considerable areas of Europe, Asia as well as America and Africa, this work is not only of local interest but is valuable the whole world over.   V. H. R.

Books on Calculus. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1),

Technical Calculus with Analytical Geometry. By A. J. Washington. 1966. Pp. 440: Price 51 *sh.*

Calculus (Part I). By E. E. Moise. 1966. Pp. 498. Price $ 6.75.

The first publication is an introductory textbook on calculus specially suited to students of electrical and mechanical technologies. The topics covered are basic analytic geometry, differentiation and integration of algebraic and elementary transcendental functions, partial derivatives and double integrals, expansion of functions in series, differential equations of first and second orders, Laplace transforms. The book contains a large number of worked examples and exercises.

Prof. Moise in his book has adopted a somewhat new method of presentation that should prove wholesome, and make study of calculus interesting. The fundamentals are developed in a thorough manner so that the ideas get deeply fixed in mind, and the student is enabled to find out for himself the application and extension of these ideas to a variety of problems. The problems have been carefully selected and graded to encourage the diligent student to pursue the subject. This introduction to calculus is to be in two parts: Part I contains the fundamentals of the subject to be covered in a one-year course; Part II will contain all other topics that are usually included in Introductory text-books.   A. S. G.

Lasers (Vol. 1). Edited by Albert K. Levine. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1966. Pp. 365. Price $ 14.50.

In the less than eight years (1958) since the first discovery of the ruby laser, the field has developed rapidly in diverse directions. The successful techniques for the production of giant laser pulses opened new areas of investigation such as frequency doubling, production of coherent Raman radiation, and non-linear optical effects. There has come a need for a review series which will from time to time supply the overall picture of advancement that is taking place in this field.

Lasers is a new Series of Advances whose publication is timely to fulfil this need. The contributing authors are scientists who are intimately associated with the expansion that has taken place in specialised directions, and so can write with authority on the subject that each has chosen.

The contents and authors of the first volume are as follows: Pulsed Ruby Lasers, by V. Evtuhov and J. K. Neeland; Optically Pumped Pulsed Crystal Lasers other than Ruby, by L. F. Johnson; Organic Laser Systems, by A. Lempicki and H. Samelson; Q Modulation of Lasers, by R. W. Hellwarth; Modes in Optical Resonators, by Herwig Kogelnik.
        A. S. G.

Instrument Industry Souvenir. (All-India Instrument Manufacturers and Dealers Association, A-32, Navyug Nivas, Lamington Road, Bombay-7). Price Rs. 5·00.

The All-India Instrument Manufactures and Dealers Association (IMDA) have brought out a Souvenir volume to mark the occasion of their

decennial celebrations 1956-1966. The handbook provides much useful information connected with the manufacture and sale of instruments in the country. Thus there are Tables of exports and imports of instruments for the decennial period 1955 to 1965, Industrial Licenses, Foreign Collaborations in Instrument Industry, Directory of Instrument Dealers and Manufacturers, and List of Instruments made in the country by member concerns of IMDA.

The volume will be useful to all those interested in the manufacture and supply of instruments.   A. S. G.

British Initials and Abbreviations. By Ian Wilkes. (Leonard Hill Books, 8-10, King Street, Hammersmith, London W. 6), Pp. 125 + Index. Price 45 *sh.*

This is the second edition of the book which has been revised and enlarged. It gives the names and addresses of practically every organization in Great Britain. Besides, international organization of which Britain is a member have been included. The extensive index of about 40 pages at the end of the book, arranged under subject headings, will help easy reference and identification.

World List of Abbreviations. By F. A. Buttress. Leonard Hill Books, 8-10, King Street, Hammersmith, London W. 6), 1966. Pp. 186. Price 35 *sh.*

The third edition of the *List* contains over 9,000 items of acronyms and their expansions to cover scientific, technological and commercial organizations existing throughout the world (*minus* Russia and a few other countries). Addresses have not been included.   A. S. G.

Deductive Organic Chemistry. By K. Conrow and R. N. McDonald. (Addison Wesley Publishing Co., Inc., 10-15, Chitty Street, London, W. 1), 1966. Pp. 405. Price $ 6.00.

How and what to teach in organic chemistry in a limited period of one semester so that the student gets the maximum benefit? This is the question that the authors have set before themselves in writing this text, and have succeeded to some extent. The approach in this *Short Course* is to present the basic principles involved in the behaviour of organic chemicals and to outline the reasoning by which the facts of organic chemistry can be deduced.

To the above on the organisation, the last two chapters are devoted to explaining the basic principles of the chemistry and compound formation. The next seven chapters deal with the preparations of organic compounds. The last two chapters bring out the use of organic compounds in biology and industry.

Chemistry Calculations. By A. [...] (Holden-Day Inc., San Francisco, 1966. Pp. 34. Price $ [...] Soft covers.

This is an elementary book written for beginning students of chemistry. Together with the application of simple algebraic principles to simple chemical problems. In one chapter elementary principles of arithmetic and algebraic operations are explained in detail, and this is followed by applications of these operations to simple chemical calculations. The book can be used as a supplement to a chemistry text book.   A. S. G.

Books Received

Introduction to Inorganic Reaction Mechanism. By J. C. Lockhart (Butterworth & Co. Ltd., 88, Kingsway, London W.C. 2), 1966. Pp. ix + 113. Price 18 *sh.* 6 *d.*

Internal Factors in Evolution. By L. L. Whyte (Tavistock Publications, 11, New Fetter Lane, London E.C. 4), 1965. Pp. xxii + 116. 18 *sh.*

Class Work with Fungi: Notes for Teachers. By H. A. Dade and Jean Gunnell (Commonwealth Mycological Institute, Kew, Surrey, England), 1966. Pp. 55. Price 10 *sh.*

Scientific Research in British Universities and Colleges, 1965-66. (Department of Education and Science, Curzon Street, London W. [...]). Vol. I: *Physical Sciences,* Pp. xiv + 413. Price £ 1 17 6; Vol. II: *Life Sciences,* Pp. xxi + 426. Price £ 2 0 0.

Russian-English Dictionary of Prestressed Concrete and Concrete Construction. Edited by B. C. Gerwick, Jr., and P. V. Peters (Gordon and Breach, Science Pub., New York), 1966. Pp. 113. Price $ 20.00.

Practical Hints on Absorption Spectrometry 200-800 m. By J. R. Edisbury (Hilger and Watts Ltd., 98, St. Pancras Way, London N.W. 1), 1966. Pp. 113. Price $ 20.00.

THE INTERPLANETARY MEDIUM

U. R. RAO

Physical Research Laboratory, Ahmedabad, India

UNTIL recently, the interplanetary medium was assumed to be devoid of all matter. The earth's magnetic field, which is of the order of 0·5 gauss at its surface, decreases to less than 1 gamma (10^{-5} gauss) within a few earth's radii. The magnetic fields, due to sun and other planets, will also decrease to an insignificant value within a short distance from their surface.

The early evidence to the contrary came from the study of Chapman and Ferraro. They explained the increase of earth's magnetic field in the initial phase of a magnetic storm as due to the compression of the earth's field by plasma emitted from active regions on the sun's surface. From the time delay between the eruptions on the sun and the occurrence of the magnetic storm the velocity of the plasma was inferred to be about 1,000 km./sec. Biermann's[1] results on cometary tails and Blackwell and Ingham's[2] results on the nature of zodiacal light further strengthened the above conclusion.

Starting from Chapman's idea that due to the high thermal conductivity, the corona populated by hot (10^6 degrees K) ionized hydrogen extends to a distance of several solar radii in space, Parker[3] showed that, at large distances from the sun, the thermal energy of the gas will exceed gravitational energy and the gas will be free to escape. Under these conditions, the corona will continually expand. Assuming a coronal temperature of 10^6 K, Parker showed that the solar plasma will attain a streaming velocity of about 500 km./sec. at about 30 solar radii beyond which the velocity will remain practically constant. The magnetic energy density due to sun's dipole field of about 1 gauss at the sun being too small compared to the kinetic energy of the gas except in the low corona, the magnetic field does not exert an appreciable effect on the radially moving solar wind.

According to the concept of the "frozen in" field, which was first proposed by Alfven, the radially outward streaming solar plasma must pull out the solar dipole field. At great distances from the sun, the field lines which are firmly anchored to the plasma will be stretched in the form of a spiral known as "Archimedes Spiral", even though the plasma will move radially outwards. The angle which the corotating spiral field line makes with the sun-earth line at a point in space is given by

$$x = \frac{WR}{V_s}$$

where W is the angular velocity of sun, R is the radial distance of the point of observation and V_s is the velocity of the solar plasma. With a plasma of velocity 400 km./sec. the field lines would make an angle of 45° with the sun-earth line at the orbit of the earth.

The solar wind radially flowing outward from the sun compresses the geomagnetic field as it interacts with it, confining the geomagnetic field to a limited volume of space known as "magnetosphere". The boundary of the magnetosphere, where the kinetic energy of the plasma balances the magnetic energy of the earth's magnetic field, is called the "magnetopause". The magnetopause lies between 10–15 earth radii (radius of earth is about 6,000 km.) on the sunward side. On the dark side of the earth where the forward momentum of the solar plasma is not effective in confining the geomagnetic field, the tail of the magnetosphere is elongated in the form of a tear drop to at least half-way to the moon. Results from Explorer 14[4] showed that the termination of the geomagnetic field at the magnetopause is also coincident with the termination of the trapping of energetic particles as well as the appearance of thermalized plasma.

The magnetic field measurements by Explorers 12 and 14 and IMP satellites clearly show that besides the conspicuous features interpreted as indicative of the magnetospheric boundary, there exists a highly fluctuating weaker magnetic field beyond the boundary to a radial distance of about 17 earth radii (Fig. 1). The termination of this region is characterised by an abrupt change in the magnetic field. Beyond this region, the magnetic field is very uniform and regular. From the analogy of the formation of a shock wave in the supersonic flow of a compressible gas around a solid object, the transition region between the regular but weak interplanetary field, and the highly fluctuating component is considered to coincide with the presence of a shock wave around the magnetosphere. The region between the shock wave and the magnetospheric boundary is called the

"magnetosheath". The magnetosheath having a weak and irregular field is characterised by the presence of thermalized plasma[5,6] and the presence of intense fluxes of electrons[7] with energy greater than 45 Kev. Thus, as shown in
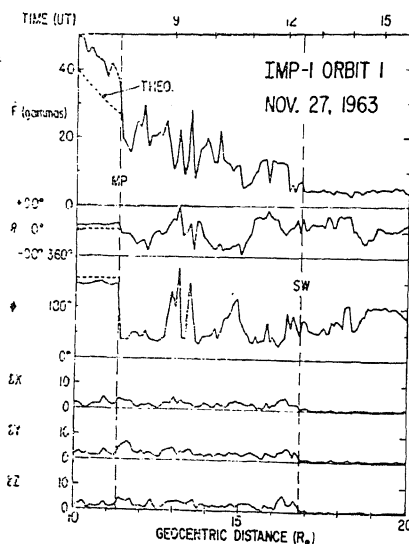
FIG. 1. The interplanetary magnetic field observed by the IMP-1 satellite. The magnetosphere boundary at $11 \cdot 3$ R_o and the shock wave at $16 \cdot 8$ R_o can be clearly seen in the figure.

Fig. 2, we may consider the extra terrestrial space to be divided into three regions.
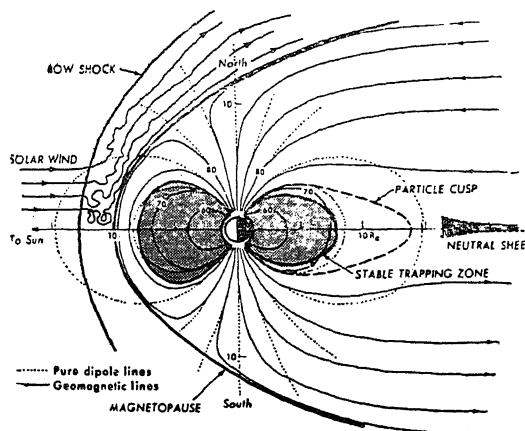
FIG. 2. Summary of the results on mapping of the terrestrial magnetosphere boundary with the interplanetary medium. The shape and the position of the shock wave and the magnetopause are indicated. The presence of intense fluxes of electrons of energy greater than 45 Kev observed by Anderson in the geomagnetic tail region is also shown.

1. The *interplanetary* region where the properties of the interplanetary medium are undisturbed by the presence of the earth,

2. The *magnetosheath,* associated with the interaction of the solar wind with the geomagnetic field, and

3. The *magnetosphere* within which the geomagnetic field is contained.

In our review, we will concern ourselves only with the interplanetary region, that is not affected by the presence of the earth and its magnetic field.

LARGE-SCALE STRUCTURE OF THE INTERPLANETARY FIELD DURING SOLAR FLARES

The quiet-time interplanetary field structure will be considerably changed at the time of violent solar eruption or flares. The velocity of plasma, emitted from sun at the time of flares, will be considerably greater (about 1,000 km./sec.) than the velocity of quiet-time solar plasma. At the region where the high velocity plasma compresses the field lines of low velocity plasma ahead of it, a blast wave is formed according to Parker.[8] As seen in Fig. 3, the field lines between the sun and the
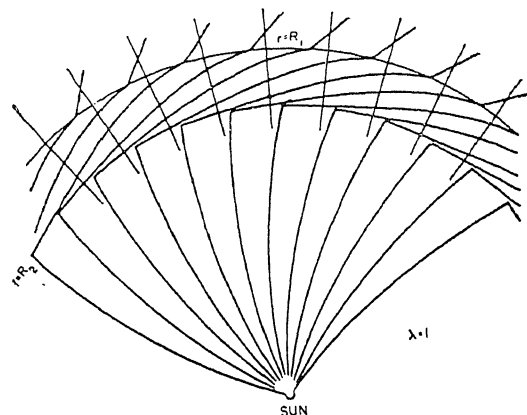
FIG. 3. The blast wave model of Parker as seen from the North ecliptic pole. The field lines are almost radial from the sun to a distance $r = R_2$ due to the high velocity post-flare plasma. Beyond $r = R_1$, the spiral field, due to the quiet solar wind, can be seen. Between these two regions, the field lines are compressed due to the blast wave.

blast wave are very nearly radial due to the very high velocity of the solar plasma emitted during the flare. In the region where the field lines are compressed due to the interaction of high velocity plasma with the low velocity plasma ahead of it, the angle between the field lines and the radial direction is larger.

Convincing experimental evidence for the existence of interplanetary magnetic field structures in the form of spiral pattern emerged from McCracken's study of solar flare increases. Calculating the complex trajectories of cosmic-

ray particles in the geomagnetic field,[10] Mc-Cracken was able to show that each neutron monitor responded to primary cosmic-ray particles arriving from a narrow region of space in the sky. This region called the asymptotic cone of acceptance of the detector scans the entire celestial sphere as the earth spins on its axis. Analysing the data from a number of neutron monitors, McCracken concluded that when the active region producing the flare is located on the western limb of the sun, the spiral magnetic field structure is able to establish a connection between this region and the earth. The relativistic particles produced will thus be guided by the magnetic lines of force and hence will be able to reach the earth in the shortest possible time. The observed increases will also be highly anisotropic in the initial stage, the excess radiation coming mainly from the direction 50° to the west of the sun. With the progression in time, the flare increase becomes completely isotropic which McCracken attributed to the scattering of the cosmic-ray particles by the small-scale magnetic field irregularities of scale size of about 0·01 A.U.

Examining the consequences of an Archimedes spiral field upon which small-scale field irregularities are superimposed, Parker[12] and Axford[13] have predicted that cosmic rays, whose gyroradii are small compared to the dimensions of the ordered component of the interplanetary magnetic field, will corotate with the sun. The corotation effect will produce a diurnal variation of cosmic-ray intensity of about 0·5% in the energy range 1–100 Bev, the maximum flux coming from the 1800 hours direction. The properties of the average diurnal variation derived from a large number of neutron monitors have been shown by McCracken and Rao[14,15] to be consistent with the predictions of Parker-Axford theory. McCracken and Rao[16] have further investigated the properties of the diurnal variation over an entire solar cycle and have concluded that the frequency of occurrence and the characteristics of magnetic field irregularities of scale size 10^{-3}–10^{-1} A.U. are invariant with respect to the phase of the sunspot cycle.

SOLAR WIND MEASUREMENTS USING SPACE PROBES

The early attempts to observe the interplanetary plasma directly by the Russian group using Lunik space probes and by Rossi and his group using Explorer 10 established the existence of a radial solar wind. The strongest direct evidence for the existence of a *continuous*

flux of solar wind was obtained by the positive-ion spectrometer on Mariner 2. From approximately 40,000 plasma spectra received during a period of about 5 months in the later part of 1962, Snyder, Neugabauer and Rao[17,18] showed that the solar wind was continually emitted radially from the sun with a velocity ranging between 300–1000 km./sec. and with an average density of about 5-10 protons/cm.³ They further showed (Fig. 4) that the solar wind
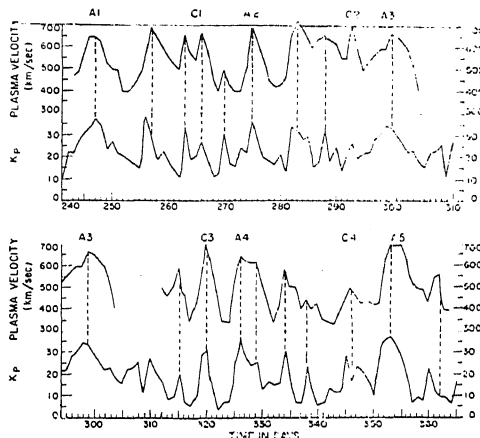
FIG. 4. Daily mean solar wind velocity observed by Mariner 2 during the period August 19 to December 1962. The predominant 27-day recurrence tendency exhibited by solar wind velocity and a one to one correlation with the K_p indices are easily evident from the figure.

velocity exhibited a strong 27-day recurrency tendency, a close association with M region storms, and an extremely good correlation with the K_p indices. The average proton temperature of the plasma was found to be about 2×10^{5}° K. The solar wind velocity which was constant between 1·0 to 0·7 A.U. contained about 5% of alpha particles. The average properties of the solar plasma, derived above, have been further verified by the Russian workers[19] using Venus 2 and Venus 3 probes and by Bridge et al.[20] and Wolfe et al.,[21] using both IMP satellites and Pioneer 6 and 7 space probes.

The preliminary results of Wolfe et al.[22] obtained from high resolution instrument on board Pioneer 6 deep space probe shows that the previous assumption of radial plasma flow is not completely correct and that the deviation from the radial flow can be as much as 5°. The ion temperature parallel to the magnetic field often exceeds the perpendicular temperature by an order of magnitude. Further analysis on the high degree of thermal anisotropy of the plasma ions and the non-radial nature of the plasma may lead to an understanding of the interaction of plasma with the magnetic field.

MEASUREMENT OF INTERPLANETARY MAGNETIC FIELD USING SPACE PROBES

The early measurements of magnetic field using space probes were not very reliable due to the contamination of measurements by the magnetic field of the magnetic materials in the space-crafts. Our best information on the interplanetary magnetic field comes from the work of Ness[24] using a rubidium vapour magnetometer on IMP-1 satellite. The results showed that the interplanetary magnetic field varied between 4 and 7 gammas with occasional decreases to 1 gamma and occasional increases to 10 gammas. The direction of the field on an average was about 45° to the earth-sun line, thus showing good agreement with the spiral structure of the interplanetary magnetic field predicted by Parker and experimentally deduced by McCracken.

Even though the field vector lies predominantly in the plane of ecliptic often it is observed to make an angle of 20° with the plane of ecliptic. Wilcox and Ness[25] further showed that interplanetary magnetic field is divided into sectors, the field direction in adjacent sectors being opposite, one away from the sun and the other towards the sun. The large-scale sectorial structure shows a 27-day recurrence period equal to the synodic rotation period of the equatorial region of the sun implying that the interplanetary field corotates with the sun (Fig. 5). From a
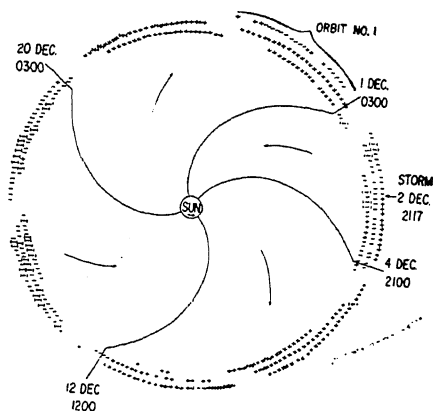
FIG. 5. Structure of the interplanetary magnetic field direction for solar rotations 1784 to 1786 as observed by IMP-1 satellite. The interplanetary field is shown to have a corotating sector structure with a strong 27-day recurrence tendency. + sign indicates the field direction away from the sun and − sign indicates the field direction towards the sun.

cross-correlation of the observed field direction with the direction of photospheric field of the sun, they conclusively proved that the field lines passing through the photosphere near the

center of visible disk of the sun, are dragged out by the solar wind to become a part of the nearby interplanetary field.

The study of low energy cosmic ray increases by Bryant et al.[26] and by the Iowa group shows the existence of a strong recurrence tendency of such increases associated with M-region storms. These isotropic increases which are generally not associated with either type, IV type radio emission or optical flares, found to occur immediately after the sector boundary of the magnetic field. The recent cosmic-ray observations on Pioneer 6 by McCracken, Rao and Bukata[27] have revealed the existence of Forbush type decreases of cosmic-ray intensity which are intimately correlated with the M-region magnetic storms. These recurrent decreases have been interpreted as due to the exclusion of galactic particles by enhanced magnetic field strength within the standing shock wave created at the interface where the fast plasma from a 'hot spot' overtakes the slow plasma from the remainder of the corona.[28] As shown in Fig. 6, which applies to the
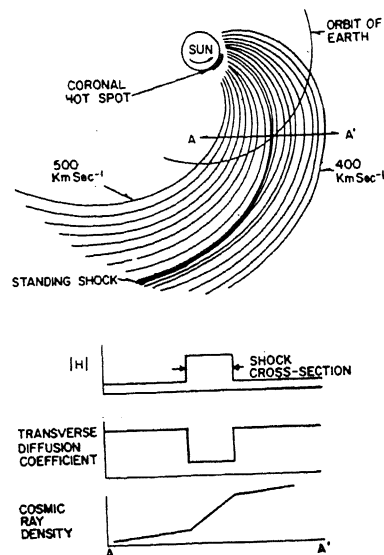
FIG. 6. The model of the standing shock wave generated by a single coronal hot spot. The intense interplanetary magnetic field at the shock prevents galactic particles from entering the region inside the shock.

instantaneous situation, an observer crossing from outside to inside the shock will see a steadily decreasing cosmic-ray intensity with the passage of time. The intensity inside the shock will recover to its normal value due to the longitudinal diffusion. Comparing the onset of recurrent Forbush decreases with the sectorial boundaries of interplanetary field

observed earlier by IMP-1 and Mariner IV space-crafts, McCracken, Rao and Bukata concluded that the onset of Forbush decreases correlated well with the sectorial boundaries suggesting that the standing shock waves involved to explain the recurrent Forbush decreases define the edges of these sectors.

The initial results from Pioneer 6 by McCracken, Rao and others[29] have already provided a great insight into the large-scale structure of interplanetary magnetic field. During the period of its operation from December 1965 to May 1966, more than 16 solar flare increases have been observed by the cosmic-ray detector designed by the above authors. They have shown that the cosmic radiation flux of mean energy 13 Mev/nucleon exhibited extreme anisotropies practically throughout each flare effect, anisotropies persisting in excess of 48 hours (Fig. 7). The
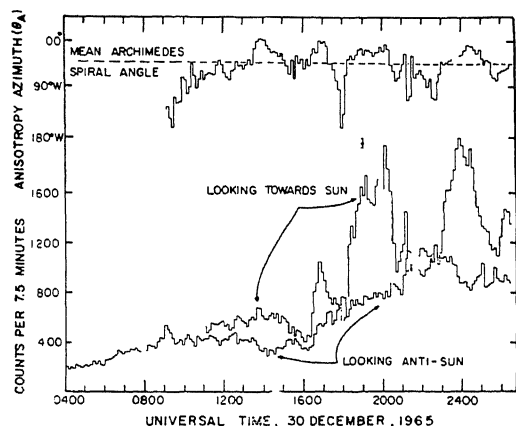
FIG. 7. The cosmic-ray anisotropy during the initial stages of the flare effect that commenced on December 30, 1965 as observed by Pioneer VI. The figure shows the 7·5 minute samples from two directions one looking towards the sun and another looking in the anti-sun direction. The mean directions of anisotropy during the same period are also shown in the figure.

direction of anisotropy has been observed to exhibit marked and abrupt changes the maximum flux coming sometimes from even the anti-sun direction. The direction of anisotropy shows one to one correlation with the direction of the interplanetary magnetic field measured by Ness[30] on the same space-craft. These results indicate that the cosmic radiation was flowing away from the sun along well-defined and intertwined filamentary magnetic field structure embedded in the solar wind. The great persistence of extreme anisotropies indicate that the fields within each filament are very well ordered in so far as 13 Mev particles

are concerned. The abrupt changes in the directions of anisotropy and of the interplanetary magnetic field occur as different corotating filaments pass by the space-craft, the magnetic field in adjacent filaments being non-parallel to each other. The filaments have a typical scale size of 3×10^6 km. which is about 21 gyroradii for 13 Mev particles. The cyclotron radius of 1 Mev proton being about 2×10^6 km. would sample the field in more than one filament in each cyclotron revolution experiencing scattering as it passes from one filament to the other. Thus the anisotropies of high energy particles will be comparatively short-lived.

In summary, the interplanetary field seems to be populated with filaments containing well-ordered magnetic fields, which are rooted to the sun, and which are intertwined and twisted with immediate neighbours *en route* to the orbit of earth. The whole population retains the general Archimedes spiral field configuration, even though on any given tube, local deviations from this pattern do occur. These results have changed our picture of the interplanetary field completely. The presence of small-scale scattering centres with interplanetary magnetic field to explain the short-lived anisotropy in flares is not needed any more. The same function is achieved by the filamentary magnetic field structure of small dimensions. Further analysis of Pioneer 6 and 7 deep space probe cosmic ray and magnetic field measurements are bound to add a wealth of information to our existing knowledge.

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KHAT AND CONGENITAL ABNORMALITIES

Prof. ABDEL HALIM KAMEL, Dr. EZZ ELDIN SAID HUSSAIN and
ELSAYED MOHAMMED HAMMOUDA

Faculty of Science, Am Shams University, Cairo, U.A.R.

KHAT addiction is still a problem in Yemen and other Arab countries. The problem was brought to the attention of the W.H.O. Commission on narcotic drugs in 1956, since then it had been discussed at successive sessions.[1,2] The question to be answered was whether Khat had the ill-effects comparable to those drugs under international control, or whether it is completely harmless and does not warrant any international action. The Commission came to the conclusion that nothing could be done until the medical aspects of the problem are studied. That study had not yet been undertaken because the chemical and the pharmacological identification of the active ingredients of Khat had not been encountered.

It is due to this point that the idea arose to investigate the effects of the crystalline Khat alkaloids on the developing chick embryo hoping to start a series of research work that would justify appraising Khat as a harmful drug.

To 25 gm. finely ground Khat leaves, 70 ml. ether and 35 ml. chloroform were added. The dried leaves were shaken and then allowed to stand for 10 minutes. 5 ml. of diluted ammonium hydroxide were added and shaking was continued for 6 hours followed by extraction for further 6 hours with the same solvent. The filtrate was extracted thrice with 10 ml. portions of Normal sulphuric acid. The acid extract was left to evaporate at room temperature. White needle-like crystals were then obtained, these were recrystallised from ethanol, dried, weighed and used as such for the purpose of the present experiments.

White Leghorn fertilized eggs were injected with $\frac{1}{2}$ c.c. distilled water containing 10 mgm. of crystalline Khat extract after 24 hours incubation. The eggs were then re-incubated for further 24, 48 and 72 hours before sacrificing the embryos.

Figure 1 shows a Khat extract-treated embryo aging 96 hours with monstroud phenotype. It is clear that nearly half the blastoderm had been degenerated. In this respect, Khat resembled colchicine which was found to cause the degeneration of a part of the blastodisk.[3] The process of cranial flexure was stopped at a level of a more early stage of 43 hours. The cervical region of the embryo was prevented from further flexion, and persisted at the long axis of the embryo. The caudal flexion failed completely to start, thus the characteristic C-shape of similarly aged normal embryos was lost; an abnormal S-figure was acquired instead. This may be attributed to the complete paralysis of the posterior half of the embryo from performing any process of the positional orientation. The process of torsion could, however, take place in the anterior half of the body.

The prosencephalon (PROS.) could not differentiate into the diencephalon and telencephalon. Similarly, the mesencephalon (MES.) was not able to add to its wall the characteristic thickening. The rhombocephalon, however, could differentiate into the meten-MET. and myelencephalon (MY.) though it was reduced in size. The neural tube (NT.) took a zig-zag S-shaped pathway subsequent to the abnormal figure of the embryo. Of the special

sense-organs, the eye (EYE) and the auditory vesicle (AU.V.) could make feeble appearance but the olfactory pit was completely blocked.

Khat also retarded the development of the heart of this embryo to a stage corresponding

The body musculature was likewise affected by the extract; only 30 paired mesodermal somites (MES.S.) could be traced at this stage. Moreover, the extract prevented the appearance of the limb buds.
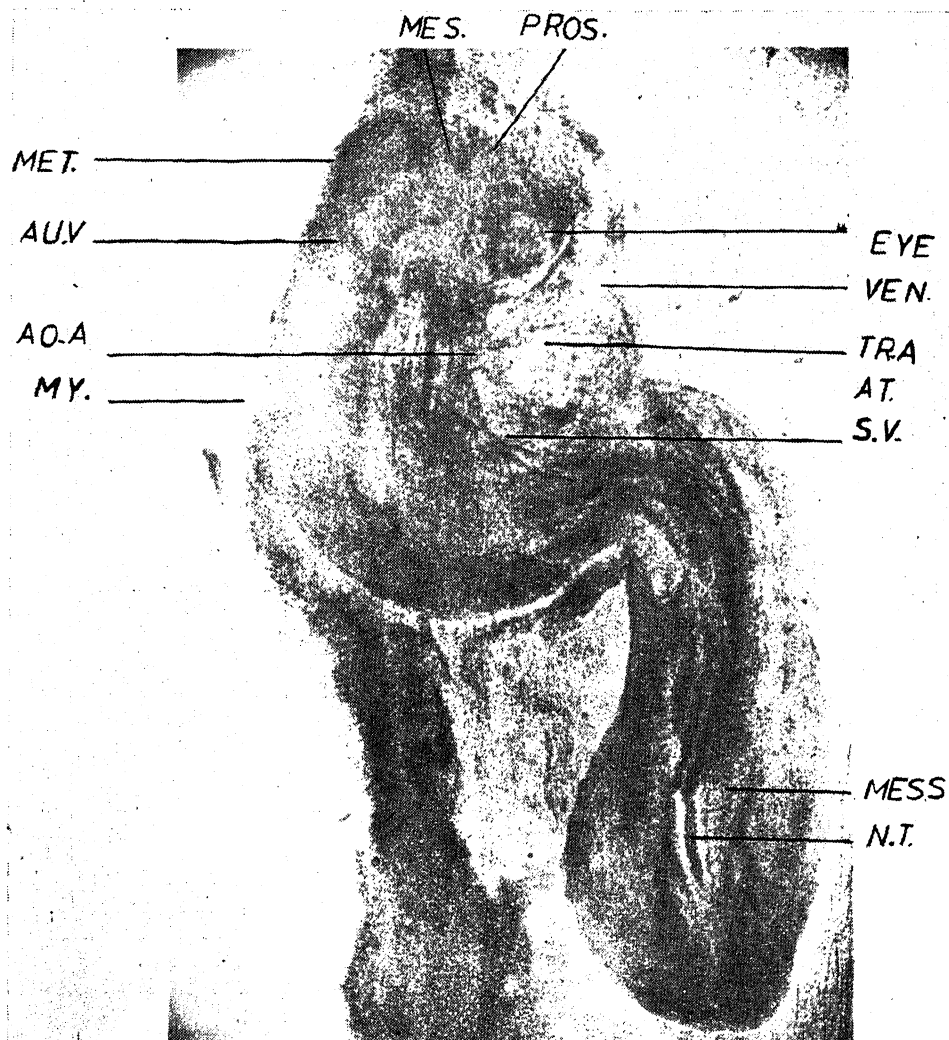
FIG. 1

to 55 hours. The truncus arteriosus (TR.A.) arose at a relatively retarded cone-like structure. The ventricle (VEN.) got twisted on itself forming a retarded U-shape in an abnormally horizontal plane. The sinus venosus (S.V.) was still represented by paired primordia where the common cardinals are supposed to enter the omphalomesenteric veins.

Further details of the effect of Khat on the early stages of the chick embryo will be reported later.

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PERSPECTIVES IN BIOLOGY : THE INTERNATIONAL BIOLOGICAL PROGRAMME

B. R. SESHACHAR*

Chairman, National Committee for Biological Sciences

THE human population on this planet is increasing at an alarming rate and the problem of feeding, clothing, housing and providing gainful and satisfying employment to this ever-increasing population is becoming a formidable task. If the population explosion goes on, in much the same manner as it has done in the last few decades, it will outstrip all efforts to increase world's resources. Concerted efforts are therefore being made all over the world to take stock of our biological resources, preserve and exploit them, and explore the untapped food resources of the seas, rivers, lakes, and land. This is a world-wide problem and no single country or nation could do this on its own. International co-operation is imperative. Such co-operation has, in the past, produced significant advances in other fields in the physical sciences. It has hardly been tried in biology. Even the techniques used by biologists the world over are not standardized, and often, data from one part of the world cannot be compared with those from other areas, nor inferences drawn.

The International Biological Programme (IBP) has been set up for this purpose. It will stimulate studies in environmental Biology and direct its activities towards a renewed thinking of Man in relation to his environment; it will focus attention on world's resources and their proper utilization; it will help create new resources; it will assist in the understanding of the needs of man in his wide and varied environments.

The IBP is motivated by a global purpose. Its objectives are essentially twofold : it has conceived a world-wide basic inquiry into organic production on land, in the freshwaters and the oceans of the earth with a view to making estimates of the possible output of existing as well as new and potentially promising natural resources. In addition, the programme envisages an international basic study of human adaptability under varied and changing conditions.

There is a great urgency for conducting these studies. Time is of essence. Man and his environment are undergoing rapid changes. This is not a local or isolated phenomenon. These vast changes in human societies and the milieu in which human beings live are taking place gradually in some places and with dramatic suddenness in others all over the world. Before opportunities for such a study are irretrievably lost, the international programme will have to be completed.

There are many ways of looking at the problem. Ideally it can be thought of as having 4 essential components : Basic biological investigations in relation to (1) human genetics and adaptability, (2) human nutrition, (3) human health and freedom from disease, and (4) conservation and study of natural biological communities.

Admittedly this is an ideal approach which however cannot be implemented in practice. Realizing the many practical difficulties, the IBP has delimited its activities to the following sections :

PT : Productivity of Terrestrial Communities.
PP : Production Processes.
CT : Conservation of Terrestrial Communities.
PF : Productivity of Freshwater Communities.
PM : Productivity of Marine Communities.
HA : Human Adaptability.
UM : Use and Management of Biological Resources.

An International Scientific Committee (SCIBP) consisting of about 25 members representing the principal regions of the world has been set up with its headquarters in London. The present President of the Scientific Committee is Prof. J. G. Baer of Switzerland and the Scientific Director, Dr. E. B. Worthington. The Central Office of the IBP is located at 7, Marylebone Road, London N.W. 1.

Each of the sections has a Committee to assist it in the formulation of the relevant part of the programme. All sections have one

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* Professor and Head, Department of Zoology, University of Delhi, Delhi-7.

common aim, *viz., "The Biological Basis of Productivity and Human Welfare"*.

The first phase of the programme comprises design and feasibility studies, initiation of pilot projects and organization of symposia. In the second phase, due to start in 1967, the full programme will be operative.

In India, a National Committee for Biological Sciences has been set up by the Government of India to co-ordinate and serve as a clearing house for the biological work conducted under the various organizations in the country and to co-operate with the International Special Committee (SCIBP). Sectional Committees for the seven sections will soon be constituted and the IBP programme initiated.

India like many other developing countries is faced with the twin problems of population explosion and inadequate food supplies. We should not only produce more, to feed the 12 millions being added to our population every year, but we should also check population growth. We have only just realised the need for improved agricultural methods and technology towards increased food production but the spectre of over-population stalks all the time bringing in its wake several problems often entirely unrelated to food shortage and improper housing. It is therefore clear that improvement of our resources should keep pace with all-out efforts to check population growth.

The objectives of the different sections are :

PT.—The section comprises studies of selected communities representing major ecosystems to obtain basic data on production levels, energy flow and mineral and water cycling. It involves close co-operation between plant and animal biologists, chiefly ecologists, taxonomists and physiologists. Collaboration with specialists in other disciplines such as meteorology, pedology, geography, agronomy and forestry is necessary for fruitful investigations. In India, delimitation of different vegetational zones and study of vegetation succession in them have been accomplished in the Terai forests of Himalayas, the Tectona forests of Madhya Pradesh and the humid forests of Western Ghats. However, studies of energy flow in these ecosystems are yet to be initiated on a large scale. Also, under this section, cereal crops will be given high priority as they form an important part of our diet.

PP.—The aim of this section is to study biological fixation of nitrogen and its circulation in living matter and also the utilization of solar energy. Methods and techniques for evaluation of photosynthetic activity should be standardized so that they could be used for determining photosynthetic activity per unit area.

CT.—The object of this section is to study wild and semi-wild ecosystems and conserve them. The IBP will not undertake a preservation action programme but will make a scientific evaluation of the natural areas of the world as a basis for such a programme.

PF.—The scope of this section is to determine the basic factors of production and metabolism at all trophic levels in representative running and standing waters, scattered over the major climate regions. Primary productivity studies in the lakes, rivers and reservoirs of India have been few and far between and there is great need for intensifying them.

PM.—The object of this section is to study production in the marine environment and to exploit the fishery resources of the sea. In addition to rainfall and radiation, the marine meteorological conditions, such as vertical water movement, which bring nutrients upto the euphotic zone from the deeper layers, are important in enriching the sea. Upwelling of deep nutrient-rich waters influences the distribution and abundance of plankton and in turn of fishes. New areas of upwelling in the Arabian Sea and the Bay of Bengal have been recently discovered, largely due to the co-operative efforts of the countries participating in the International Indian Ocean Expedition. Since these areas are potential fishing grounds, efforts must be made to ensure proper exploitation. Oceanographic research can aid in a practical way in utilizing the resources of the sea.

This section also deals with fundamental ecological aspects as a necessary prelude to the scientific basis for the improvement of accessible resources in the seas and oceans. These would include coastal belts, lagoons, estuaries and mangrove swamps. Admittedly, these are useful to man as productive ecosystems but owing to reclamation, pollution and indiscriminate and unscientific methods employed to exploit them, their productivity is seriously impaired.

HA.—Modern man is busy altering his environment at an ever-increasing rate. He is synthesizing new chemical compounds with which life has never been confronted before,

using some as drugs, putting others in the atmosphere as wastes and spreading still others on crops as insecticides. Modern medical and public health practices have resulted in whole populations being injected with new chemical and biological additives. Man is migrating and mixing and he is rapidly altering his social, familial and marital patterns. The enormous advances in Science and Technology have led to many communities, which in the past were changing slowly, being transformed in a relatively short period. It is therefore appropriate that the IBP has included *"Human Adaptability to Changing Environment"* as one of the sections.

India is unique in several respects as far as its human populations are concerned. It has within its national boundaries almost all the major racial groups under a social structure which has preserved many of its early characteristics. Moreover, climatic conditions in the sub-continent vary from the extreme cold and high altitude of the Himalayas to the humid tropical conditions of South India. What is even more interesting and perhaps unique is, some of the population groups have undergone a high degree of occupational specialization extending over tens and even hundreds of generations. Some of the communities have practised inbreeding as a social norm over two or three millennia. Thus the populations of India provide unequalled opportunities for studies of human adaptability as envisaged under IBP.

The international programme under this section consists of three main categories of research projects:

1. Survey of sample populations in conformity with a world scheme:

   (*a*) extensive surveys of blood groups and other related genetic traits and

   (*b*) extensive surveys on growth and physique.

2. Intensive multi-disciplinary regional studies based on habitat contrasts to elucidate physiological and genetic processes concerned in adaptation and selection in relation to climatic and other environmental factors.

3. Special investigations on selected populations.

The actual research projects may be listed under the following heads:

   (*i*) Environmental physiology.

   (*ii*) Fitness, growth and physique.
   (*iii*) Genetics of populations.
   (*iv*) Health, nutritional and epidemiological aspects.

Although this framework is sufficiently wide, it is not unlikely that we in India might be able to enlarge upon this and may even be able to develop newer lines of investigation not envisaged here.

UM.—The primary object of this section is the co-ordination of applied programmes of International Organizations such as FAO, WHO, WMO and UNESCO. Exploration of new biological resources, improvement in methods of food preservation, pest and plant disease control are under the purview of this section. Control of pests and plant diseases are engaging the attention of many organizations in the country. Though work on food preservation and exploration of new biological resources is in progress in India, there is need for intensification of these efforts to make an impact on the large population. Seaweeds could be processed for human consumption as in Japan. Cultivation of fungi and mushrooms could be developed to augment our food resources.

The IBP is of interest to all countries of the world but is of special significance for developing countries like India. As a result of three successive plans of economic development, we have now a clearer picture of our national problems although a satisfactory solution of many of them is not yet in sight. Better standards of health that the people now enjoy as a result of these plans have given rise to a rapid rate of increase of the population. Food production has also increased during these successive plans but not enough to make a serious dent in malnutrition which is still widespread.

The practical aspects of these problems are being dealt with at the highest levels in the governmental organization with the assistance of national and international agencies. These activities, however, depend on basic biological knowledge which in many cases is at present wholly inadequate and there is wide scope for promotion of appropriate studies. The value of IBP lies in strengthening international co-operation which is so essential for increasing the tempo of these activities and raising their quality. Biologists in India should look forward to a fruitful participation in this great International venture for the prosperity and well-being of man and his biological environment.

LETTERS TO THE EDITOR

ESTIMATION OF AROMATICITY FROM DILUTION SHIFTS—AN EXTENSION OF THE METHOD FOR COMPOUNDS WITHOUT PROTONS

A METHOD based on dilution shifts of protons in aromatic compounds in non-polar, isotropic solvents like CCl_4 has been reported earlier[1-3] for the estimation of aromaticity of monocyclic compounds. It is possible to extend this method to aromatic systems which may not contain protons, in the following manner : Such a compound is dissolved in benzene and the dilution shift ($\triangle\delta$) of benzene is estimated. Since benzene is a non-polar compound, one does not expect an interaction between the given aromatic compound and benzene.[1] Consequently, the following two factors affect the ($\triangle\delta$) value : (*i*) aromaticity of the solute, (*ii*) the aromaticity of benzene itself. The contribution due to second effect ($\triangle\delta_2$) can be estimated by measuring the dilution shift of benzene in CCl_4. The quantity ($\triangle\delta - \triangle\delta_2$) is evidently directly proportional to the aromaticity of the solute and inversely to its molar volume (V_m). This method has been used to estimate aromaticity of thiophene, furan and pyridine and the values obtained are given in Table I along with the values of V_m and ($\triangle\delta - \triangle\delta_2$). The ($\triangle\delta - \triangle\delta_2$). V_m value for benzene which has been assumed to be 100% aromatic has been taken as 64.[1-3] The aromaticity values are the same as those estimated by the dilution shifts of the solute protons in CCl_4.

TABLE I

($\triangle\delta - \triangle\delta_2$), V_m *and Aromaticity values for Thiophene, Furan and Pyridine*

Compound	$(\triangle\delta - \triangle\delta_2)$ ppm.	V_m	$(\triangle\delta - \triangle\delta_2) V_m$	Aromaticity (%)
Thiophene ..	0·60	77·3	46·4	72
Furan ..	0·38	72·1	27	42
Pyridine ..	0·48	80·6	39	6l

It may be noted that the method described in this note has wider application than that based on the dilution shifts in CCl_4. Further, the shifts can be measured more accurately and with ease by the present method as benzene

has a single sharp line. The earlier method involves the measurement of the shifts of ring protons in the aromatic solute which often give a complex spectrum and it is not always easy to ascertain accurately the shifts for these protons.

The aromaticities of several pentafluoro-benzenes are being estimated utilizing this method and the results will be reported in a separate communication.

Tata Institute of   C. R. KANEKAR.
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Colaba, Bombay-5,
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PREPARATION OF CHROMIUM-51 LABELLED HUMAN SERUM ALBUMIN FOR MEDICAL USE

HUMAN serum albumin labelled with chromium-51 has been used in medicine for studies of gastro-intestinal protein loss.[1] This product has been prepared by treating the albumin with chromic chloride (Cr-51) of high specific activity followed by purification by cation exchange or salt precipitation.[1] A simpler and more reliable method of purification has been developed here, based on gel-filtration over DEAE-Sephadex. The possibility of labelling the protein electrolytically with chromium-51 has also been studied.

Chromium-51 of high specific activity (100 c./gm.) available in the form of sodium chromate is reduced to the trivalent state by repeated boiling with hydrochloric acid and hydrogen peroxide and finally taken up in a pH 2-3 dilute hydrochloric acid solution. DEAE-Sephadex A-50 (Pharmacia, Uppsala, Sweden) was mixed with 20% w/w Celite 545 and loaded into glass columns (8 cm. $\times$ 2 cm.²). For labelling, human serum albumin, 20% solution (Behringwerke, Marburg Lahu Sterile, undenatured) is used.

The quantitative retention of chromium (111) on the DEAE-Sephadex gel was confirmed as follows. 10–100 μc. of the chromic chloride Cr-51 (pH-2-3) was adjusted to pH 8–9 by adding the requisite quantity of sodium hydroxide, incubated at room temperature for 1–2 hours and then passed down the column. The column was washed with 0·1 M sodium chloride solution, and the effluents assayed for chromium-51. It was found that more than 80% of the activity was retained on the column. Further washing with 0·5–1 M sodium chloride solution eluted out only less than 2% of the activity retained on the column. By using radio-iodinated human serum albumin (RISA)—100 μc.—it was confirmed that the protein is quantitatively retained on the gel at pH 8–9 from dilute saline solution (0·1 M) and is eluted out with 1 M sodium chloride solution.

5-10 millicuries of the chromic chloride solution (specific activity 100 c./gm., pH 2–3) is jetted into a 10% solution of human serum albumin, the pH of the mixture adjusted to 8–9, by adding a few drops of dilute sodium hydroxide solution (if necessary) and the mixture incubated for one hour at room temperature. The mixture is then passed down a DEAE-Sephadex column, the column washed with 0·1 M sodium chloride solution (50 ml.) and the labelled albumin eluted out with 1 M sodium chloride solution. A radiochemical yield of 30–40% is obtained. Paper chromatographic analysis[2] shows the product is radiochemically pure.

5 millicuries of chromium-51 labelled chromic chloride (pH 2–3) was electrolysed at 0·5–1 m amp. current for 2–3 hours, using a platinum anode and a rotating platinum cathode. The cathode compartment contained 10% human serum albumin solution in a dialysis bag, kept dipping in the chromic chloride (Cr-51) solution. At the end of the electrolysis, the albumin solution is dialysed against distilled water and purified by passing down the DEAE-Sephadex column. Paper chromatographic analysis confirms the purity of the product.

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POLYMETHYL METHACRYLATE IN ISOAMYL ACETATE

THE thermodynamic parameters, θ temperature, the entropy parameter ψ and the heat parameter k for various types of macromolecules have been evaluated by osmometry,[1] viscometry,[2] light scattering,[3] phase relationships[4] involving precipitation, etc. For polymethyl methacrylate in isoamyl acetate, Kirste and Schulz[1] reported from osmometry, $\theta = 57°$ C. Fox[2] reported the constant of Flarg's relationship, $K = 4·8 \times 10^{-4}$ from precipitation and viscometric studies of polymethyl methacrylate in θ solvents and found that K was independent of temperature. Varadaiah and Rao[5] on the other hand found, from viscometric studies of polymethyl methacrylate in various non-ideal solvents, that $K = 5·9 \times 10^{-4}$ at 30° C. and $K = 5·4 \times 10^{-4}$ at 65° C. We determined the value of K from viscosity measurements in isoamyl acetate from plots of $[\eta]^{2/3}/M^{1/3}$ *vs.* $M/[\eta]$ and found that it was lower than those reported by Fox, and Varadaiah and Rao and decreased with increase in temperature. Our θ values determined by precipitation studies and viscometric studies (using both Fox's and our values of K) agree and are slightly lower than those of Kirste and Schulz.[1]

Polymethyl methacrylate prepared from catalysed (benzoyl peroxide), thermal (60° C.) polymerisation of the monomer was fractionated (from benzene/petroleum ether) and the molecular weights of the twenty fractions were determined by viscosity technique using the Mark-Houwink relationships.[6] The precipitation temperatures (T_p), and hence the critical solution temperatures (T_c), of various fractions in isoamyl acetate were determined by the standard Flory method.[4]

A plot (Fig. 1, line A) of $1/T_c$ *vs.* $1/x^{\frac{1}{2}} + 1/2x$ where x is the ratio of the molar volume of polymer to the molar volume of the solvent, was linear. Plots of $\alpha^5 - \alpha^3/M^{\frac{1}{2}} \times K_r/K_0$ *vs.* $1/T$ (Fig. 1, lines B, C, D & E) were also linear ; α is the well-known expansion factor ; K_r is K at the experimental temperature T and K_0 is the value at any reference temperature (27° C. in this case).

(*i*) Our values from precipitation studies were $\theta = 50·3°$ C. and $\psi = 0·298$ and $k = 0·32$ at 27° C. (Fig. 1, line A); the average values by viscometry of $\theta = 48·5°$ C., $\psi = 0·12$ and $k = 0·13$ at 27° C. were obtained using Fox's values of K (Fig. 1, lines B and C) and the average values of $\theta = 52·2°$ C., $\varphi = 0·58$ and $k = 0·63$ were obtained using our values of K

(Fig. 1, lines D and E); (ii) The values of θ and ψ vary slightly as expected for various fractions; and (iii) the variations in the values of K (cf. Varadaiah's and ours) as well as θ (Kirste's and ours) must be traced to approximations in graphical extrapolations.
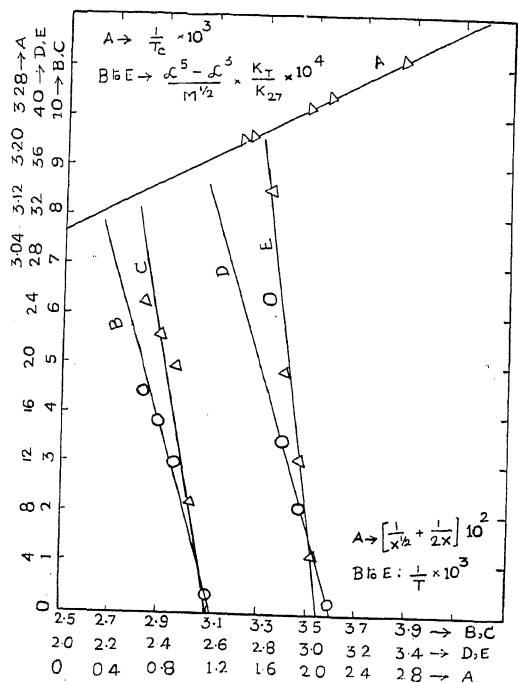
FIG. 1. Plot A. $1/T_c$ vs. $1/x^3 + 1/2x$ for polymethyl methacrylate (Molecular weight $= 2\cdot535 - 9.226 \times 10^5$) in isoamyl acetate. Plots B-E. $a^5 - a^3/M^{\frac{1}{2}} \times K_T/K_0$ vs. $1/T$. The molecular weight of B and $D = 7\cdot852 \times 10^5$ and that of C and $E = 4\cdot842 \times 10^5$. Plots B and C with Fox's values of K and Plots D and E with our values of K.

Dept. of Physical Chem.,　PADMA VASUDEVAN.
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A NOTE ON TECTORIGENIN MONOMETHYL ETHERS

IN connection with other work in progress in this laboratory the different monomethyl ethers of tectorigenin (I) were required for purposes of comparison. Three isomers are possible: (i) 7-0-methyltectorigenin (II), (ii) 4'-0-methyl tectorigenin (III) and (iii) 5-0-methyltectorigenin (IV). The first of these occurs free in the flowers[1] and the roots of *Dalbergia sissoo* and also in parts of *D. lanceolaria*; recently it has been reported to be present in 'muninga' (*Pterocarpus angolensis*).[3] The 4'-0 rhamnoglucoside of (II) has been found in the green pods of *D. sissoo*.[4] We have originally synthesized (II)[1] by the partial methylation of (I); later other syntheses were also reported.[5,6]
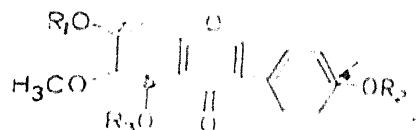
I　R_1　R_2　R_3　H
II　R_1 CH$_3$, R_2　R_3　H
III　R_2 CH$_3$, R_1　R_3　H
IV　$R_3 =$ CH$_3$, R_1　R_2　H

The 4'-0-methyltectorigenin (III) (irisolidone) occurs in *Iris nepalensis*.[7] It was earlier obtained[8] by the base-catalysed isomerisation of 7-benzyloxy 8, 4'-dimethoxy 5 hydroxy isoflavone to 7 benzyloxy 6,4'-dimethoxy 5 hydroxy isoflavone followed by debenzylation; a new synthesis has also been reported recently.[9] This compound has now been prepared as follows: tectorigenin was partially benzylated by refluxing with benzyl chloride, sodium bicarbonate and potassium iodide in acetone solution for 24 hours to yield the 7-0 benzyl ether (m.p 195–96° from methanol; green ferric reaction); the latter was converted (methyl sulphate and potassium carbonate in acetone solution for 4 hours) into 7 benzyloxy 6, 4' dimethoxy 5 hydroxy isoflavone (m.p. 153-54° from methanol). Subsequent catalytic debenzylation in ethyl acetate solution furnished the required 4'-0 methyltectorigenin (III). Its properties agreed with those described by the previous workers. For the synthesis of 5-0-methyltectorigenin, (I) was converted into the 7,4'-di-0-benzyl ether (m.p. 148°) which was then methylated to obtain the 7, 4'-dibenzyloxy-5, 6-dimethoxy isoflavone (m.p. 150°). Catalytic debenzylation of the latter gave (IV), whose properties agreed

with those described for the material by Farkas *et al.*[6]

During our earlier work on the characterisation of (II) isolated from the *D. sissoo* flowers the alternative structure of 7, 4'-dimethoxy-5, 6-dihydroxy isoflavone was also considered.[10] In order to arrive at the correct structure the natural compound was first partially ethylated (m.p. 163° from methanol) and the ethyl ether methylated (m.p. 186° from methanol); the final product would be either 5, 6, 7-trimethoxy-4'-ethoxy isoflavone or 5, 7, 4'-trimethoxy-6-ethoxy isoflavone. An authentic sample of the former was prepared as follows : condensation of antiarol and *p*-ethoxyphenylacetyl chloride under Friedel-Crafts' conditions employing excess of aluminium chloride gave 2-hydroxy-4, 5, 6-trimethoxy-4'-ethoxy phenylbenzyl ketone (m.p 50° from methanol ; purple ferric reaction). This deoxybenzoin was cyclised (ethyl formate method) to 5, 6, 7-trimethoxy-4'-ethoxy isoflavone which was identical with the substance prepared from the natural isoflavone thus confirming the structure of the latter as (II).

Department of Chemistry,   A. BANERJI.
Delhi University,   V. V. S. MURTI.
Delhi-7, *November* 23, 1966.   T. R. SESHADRI.

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STUDIES ON THALLOUS-SALICYLATE COMPLEX

THE salicylate complexes of aluminium,[1] beryllium,[2] iron,[3] manganese,[4] uranium,[5] palladium[6] and many other metals have been investigated by physico-chemical methods. No salicylate complex of thallium (I) has been reported so far, which encouraged the present investigation.

E. Merck sample of thallous nitrate and potassium-salicylate of B.D.H. make were used for the investigation. All solutions were prepared in double distilled water. For electrical conductivity measurements Doran's conductivity bridge and 'WTW' oscillator were used. All readings were taken at a temperature of $28 \pm 1°$ C.

The stoichiometry of the complex was first studied by monovariation[7] method. M/30 and M/40 equimolar solutions of thallous nitrate and potassium-salicylate were mixed by keeping the volume of thallous nitrate constant (5 ml.) and varying the volume of potassium-salicylate, conductance measurements were done after a gap of 6 to 8 hours when the equilibrium is established. A graph of conductance against the volume of ligand added shows a clear break at the ratio of 1 : 2 (metal : ligand) indicating that thallium (I) and salicylate ion combine in 1 : 2 ratio.

The composition was further confirmed by Job's[8] method of continuous variation. M/40, M/60 and M/80 equimolar solutions were mixed, with blank sets for metal and ligand solutions. Graphs of △-conductance against the percent volume of potassium-salicylate shows maxima at 66% of the ligand. This result is in accord with the previous observation.

The instability constant (K) of the complex was determined in the same way as for composition by Job's method but with non-equimolar solutions. M/100 thallous nitrate and M/20, M/25 and M/40 potassium-salicylate solutions were used. The value of K was calculated by the formula :

$$K = \frac{C\,[(p+1)\,x - 1]^2}{(p-1)\,(1-2x)}$$

where c = concentration of metal ion ; p = ratio of concentration of ligand and metal ions and x = maxima in the curve.

The average value of instability constant is calculated to be 4.75×10^{-6}.

Considering co-ordination number of thallium (I) to be four and the bidented nature of the ligand, the probable structure for thallous-salicylate complex is proposed to be :
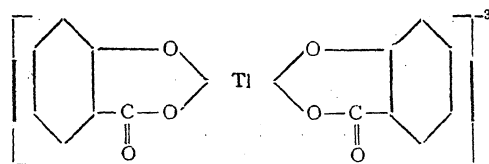
Both the carboxylic and phenolic hydrogen ions are replaced by thallous ion.

Chemical Laboratory,   K. N. Sahu.
University of Saugar,   A. K. Bhattacharya.
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FORMATION AND STABILITY OF URANYL HYDROQUINONATE

The uranyl ion is known to form stable chelates with many organic ligands.[1-4] The formation and stability of uranyl hydroquinonate has been studied in the present investigation.

Analar samples of uranyl acetate (B.D.H.) and recrystallized hydroquinone (E. Merck) were used. The experiments were carried on the polymetron pH meter and Philips conductivity bridge.

The stoichiometry of the complex was determined by titrating the equimolar solutions of M/20 uranyl acetate and M/20 hydroquinone in 1:1, 1:2, 1:3 ratios with M/2 alkali.

The chelation can be represented as follows:

The potentiometric and conductometric titrations of uranyl acetate with NaOH in presence of one mole of hydroquinone show sharp inflection at $M = 2$, where M represents moles of base added per mole of metal ion indicating the formation of monohydroquinonate, with liberation of 2 hydrogen ions in each case. The break is obtained at 2 moles of alkali even in presence of excess ligand, showing that only 1 : 1 chelate is formed.

Isolation of the Compound and Analytical Studies.—The equimolar solutions of uranyl acetate and hydroquinone were mixed approximately in 1 : 1 ratio by volume with slight excess of the ligand. The solution was refluxed. A violet solid is obtained. It was dried and its uranium content was estimated. The percentage of uranium in the complex 59·46% nearly corresponded with the theoretical value of 57·49%.

The stability constant was determined by Bjerum's method at a constant temperature 25° C. It comes out to be $21·17 \times 10^{11}$. $\triangle F$ works out to be $-16·84$ K.cals/mole.

Thanks are due to Prof. W. V. Bhagwat for providing laboratory facilities.

School of Studies in   R. Raghava Rao.
  Chemistry,   P. K. Bhattacharya.
Vikram University,
Ujjain (M.P.), *August 30, 1966.*

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The chelation by the donation of a lone pair of electrons from the hydroxy oxygen atoms makes the hydrogen atoms more mobile and acidic, thus causing the lowering of pH in the system.

Addition of alkali to the reaction mixture neutralises the hydrogen ions produced by chelation. The number of equivalents of alkali required is equal to the number of hydrogen ions liberated.

OCCURRENCE OF LUTEOLIN IN THE LEAVES OF *GMELINA ARBOREA* LINN.

Gmelina arborea Linn. (fam.: Verbenaceæ) is a large tree, generally growing wild in the agency tracts of coastal districts of Andhra Pradesh. All parts of the plant are used in medicine for curing various ailments.[1] A lignane, gmelinol was isolated by Birch *et al.*[2] from the wood shavings of *G. leichardtii.* Aggarwal and

Soni[3] have reported the chemical examination of the oil from the seeds of *G. asiatica*. No work has been reported on the chemical constituents of *G. arborea* and the isolation of luteolin from the leaves of this plant is reported herein.

The leaves of *G. arborea*, collected around Waltair, were air-dried, powdered and extracted successively with petroleum-ether, chloroform and alcohol. The petroleum-ether extract residue when chromatographed over alumina gave a neutral substance crystallising as white shining plates from benzene, m.p. 87°. The chloroform extract residue was amorphous.

The alcoholic extract was concentrated under reduced pressure and almost all the alcohol was removed by adding water at intervals. The aqueous liquid thus obtained was extracted successively with petroleum-ether, ether and chloroform. The ether extract on concentration deposited an yellow solid which on repeated crystallisations from dilute alcohol gave an yellow crystalline substance (yield, 0·1% of the dried material), m.p. 322–25°. The substance answered the characteristic colour reactions of flavones. Found: C, 62·3; H, 3·8; OCH_3, nil per cent. $C_{15}H_{10}O_6$ (tetrahydroxy flavone) requires: C, 63·0; H, 3·5%. It formed a tetraacetate, feathery needles from alcohol, m.p. 224-26°. Found: C, 61·2; H, 3·8%. $C_{23}H_{18}O_{10}$ requires C, 60·8; H, 4·0%. It formed a tetramethyl ether, prisms from benzene-petroleum ether, m.p. 189–91°. Found: C, 67·1; H, 4·8; –OCH_3, 36·3%. $C_{19}H_{18}O_6$ requires: C, 66·7, H, 5·3, –OCH_3 (4), 36·2%. The properties of the flavone and its acetate and methyl ether indicated that it might be identical with luteolin. This was confirmed by a mixed melting point determination between the acetate and authentic luteolin acetate[4] obtained in this laboratory. Further confirmation was obtained by paper chromatography including co-chromatography of our flavone with authentic luteolin in the following solvent systems: phenol-water, *n*-butanol-acetic acid-water and acetic acid-water.

We thank Dr. S. Sankara Subramanian of the Medical College, Pondicherry, for the paper chromatographic comparison. One of us (D. V. R.) thanks the University Grants Commission for a scholarship.

Department of Pharmacy,   D. VENKATA RAO.
Andhra University,   E. VENKATA RAO.
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SOME 2-3-DISUBSTITUTED QUINAZOLONES AS CENTRAL NERVOUS SYSTEM DEPRESSANTS

THE interest in the study of quinazolones was revived after they were reported as central nervous system depressants.[1] The discovery of QZ-2 (2 methyl-3-o-tolyl quinazolone) is an important landmark in the field of synthetic non-barbiturate hypnotics.[2] It has low toxicity, with a favourable therapeutic index (4) as compared to phenobarbitone (2·5). In clinical trials[3] QZ-2 has been found to be a useful and a safe hypnotic. QZ-2 is available commercially as Melsedin (Boots Pure Drug Co.) and Hypnodyne (Standard Pharmaceuticals) and so far no toxic effects worth mentioning have been reported in the literature. The anticonvulsant properties of QZ-2 have been reported in mice, rats and dogs.[4-7]

A large number of quinazolone compounds have been synthesized in an attempt to resolve the anticonvulsant activity from the hypnotic activity.[8] A potent anticonvulsant activity of B.D.H. 1880 (2-methyl-3-bromophenyl quinazolone hydrochloride) has been reported against metrazol-induced convulsions in mice.[9]

In the present study seven newly synthesized 2-3-disubstituted quinazolones have been tested in rats for their sedative and hypnotic activities. Table I gives the list of compounds tested.

TABLE I

Code No.	Chemical name	M.P.° C.
PQZ-1	2-Methyl-3-(isopropyl)-quinazolone hydrochloride	263
PQZ-2	2-Methyl 3-(*n*-butyl)-quinazolone hydrochloride	208
PQZ-3	2-Methyl-3-(hydroxy ethyl)-quinazolone hydrochloride	195
PQZ-4	2-Methyl-3-(2-pyridyl) quinazolone	164
PQZ-5	2-Methyl-3-(4-pyridyl) quinazolone	144
PQZ-6	2-Methyl-3-(anilino)-quinazolone	203
PQZ-7	2-Methyl-3-(2, 5-dimethyl phenyl)-quinazolone hydrochloride	216

The sedation was evaluated by a test[10] based on the assumption that pre-sleep or somnolence as indicated by a reduction of spontaneous activity, assumption of sleep posture and eye

closure without loss of arousability is the equivalent of the clinical state of sedation. For more objective evaluation of the sedative effects in mice the effect of compounds on forced locomotor activity[11] was studied. The percentage effect against different doses of compounds was determined on the forced locomotor activity in mice. Percentage reduction in group performance was then calculated at the time of peak effect. The ED_{50} of active compounds was calculated.[12] Hypnotic activity was assessed in rats in terms of loss of righting reflex. Doses of compounds for specified percentage effects were determined. The quantal response data were analysed by the probit method based on the maximum likelihood principle.
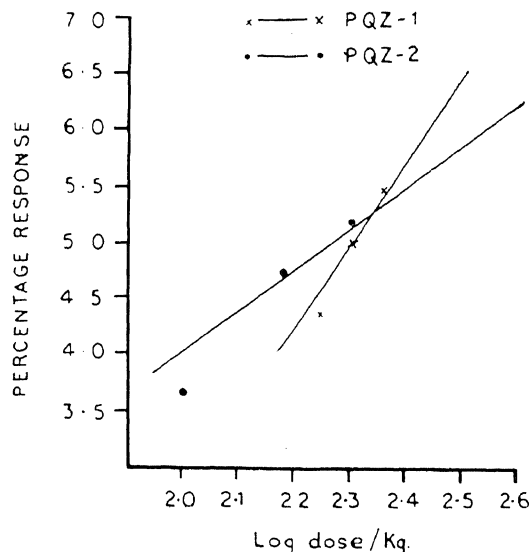
FIG. 1

Two compounds, *viz.,* PQZ-2 and PQZ-4 reduced the forced locomotor activity in mice. Other compounds showed positive sedative effect when tested. Because of the subjectivity of the latter test however and failure of these compounds to show positive effect when tested by their effect on the forced locomotor activity, these compounds were disregarded. The ED_{50} values of the two active compounds are 50 ± 2.5 and 176 ± 4.5 mg./kg. respectively. These values are less than 1/5th the approximate lethal dose. Compounds PQZ-1 and PQZ-2 have been found to possess hypnotic activity. The ED_{50} values are 181 ± 1.7 and 157 ± 6.3 mg./kg. Figure 1 shows the regression lines of these compounds for the hypnotic activity.

Upgraded Department of   P. R. DUA.
  Pharmacology and   R. P. KOHLI.
  Therapeutics,   K. P. BHARGAVA.
K.G. Medical College,
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POST-NATAL CHANGES IN LIVER AND BRAIN LIPIDS OF RATS

RECENTLY it was reported that a sudden increase occurred in total lipids of mouse liver, following separation from maternal environment.[3] These changes in lipid content were not found to be identical in all the species.[1,2,4] While comparing these values with those obtained in the cases where gestation period was longer, it was found that the latter values were significantly lower or at times identical with those before birth.

Though the rise in total lipid content is reported, no mention is made as to whether there is an overall increase in all the lipid fractions or there is a specific increase in one or more lipid constituents. It is also interesting to see whether this increase in lipids is related to liver, or other tissues also participate. Therefore, it was desired to investigate the values of total lipids and total cholesterol in liver and brain of young rats during the post-natal period of 15 days.

Rats having identical gestation period were selected. Liver and brain were homogenized mechanically. This homogenate was shaken with ethanol : ether (3 : 1) mixture. The lipid extract of the homogenate was collected in a container and dried at 60° C. This was then preserved overnight under nitrogen in a desiccator.

Double weights were checked till identical. Suitable aliquots were used for cholesterol estimation. The colour was compared at 630 mμ using B and L Spectrophotometer. The rate of growth of brain and liver were judged by comparing the ratio of the tissue weight to total body weight in a fixed period.

In rats, increased values of total lipids and total cholesterol in liver and brain are found at the time of birth. This increase is maximum during the first three days of post-natal life. Later, the brain lipids continue to increase but the cholesterol values do not show similar rise. At the same time, the rate of growth of this tissue starts decreasing while that of liver continues to increase (Fig. 1). The rapid rate
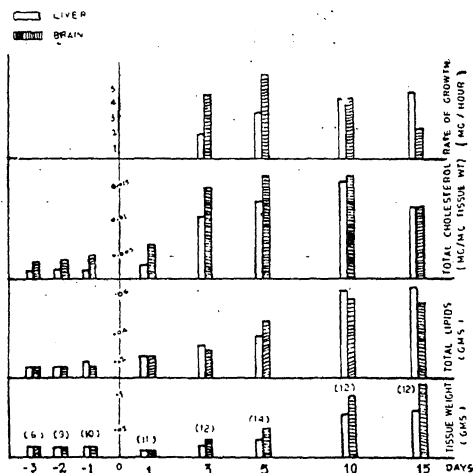
FIG. 1. Values in brackets indicate number of animals.

of lipid formation only during first ten days of post-natal life in brain tissue suggests the possibility that brain lipids are formed during the formation of structural frame. It is known that the growth of individual cells of the brain of rats takes place during the first ten days of life. The decreased rate of lipid formation with decreased rate of growth of brain tissue, after ten days, also tend to support the above conclusion that the lipids of brain are mainly for the structural framework without much metabolic participation. Progressive increase in weight of liver is accompanied with a similar increase in lipid values. Further work is in progress to study the role of newly synthesized lipids in liver for structural and metabolic purposes.

We express our sincere gratitude to Dean, T.N. Medical College, Bombay, for providing necessary facilities and encouragement. We also extend our thanks to Dr. N. A. Dabholkar, Professor of Physiology, for keen interest.

T.N. Medical College,   M. K. Vyas.*
Bombay-8, *August* 31, 1966.   K. G. Tankasale.

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OCCURRENCE OF MALACOLITE IN PYROXENE-FELSPAR ROCK NEAR CHANNAPATNA, BANGALORE DISTRICT, MYSORE STATE

AT a number of places round about Channapatna (Long. 77° 12′ 28″; Lat. 12° 39′ 25″), Bangalore District, Mysore State, rocks containing mostly dark green monoclinic pyroxene (belonging to the diopside-hedenbergite series) and a little felspar, with some vein quartz, have been noticed. These rocks occur in the field as small isolated patches and sometimes as big boulders, frequently associated with ferruginous granulites. These are prominently seen just by the roadside and very near the village Gurugal Doddi 6·5 km. from Channapatna), on the Channapatna-Bangalore Road. Within these rocks, streaks, veins and ribbons of quartz are noticed in random directions.

Microscopic examination of thin sections of these rocks revealed the presence of the mineral malacolite, whose optical properties are presented here. In the present occurrence the term malacolite is used to the member of diopside-hedenbergite series, when the mineral shows clear and prominent (001) parting plane. [*see also* Winchell (1956) and Dana (1959)].

Malacolite occurs in the rock in usually larger grains. Its optical properties are : $+ 2 V = 60°$; $Z \wedge C = 42\text{-}46°$; $N_z - N_x = 0·027$; It shows faint pleochroism with $X =$ pale green ; $Y =$ pinkish-green ; $Z =$ dark green. It shows one set of cleavage lines, short and discontinuous, paralleling the (110) plane. The other set of lines which are nearly perpendicular to the (110) cleavage are parting planes. These parting planes are long, continuous, running from one end of the mineral to the other end, and are found to be parallel to the basal plane (001). The (110) cleavages which lie between the (001) parting planes terminate against them. The intersection of the (010) and (001) planes

locates the pole of the a-crystallographic axis, whereas the c-axis is located at the point where (010) and (110) planes intersect. The angle β, i.e., the angle between a and c, is 75° (or 105°), indicating the monoclinic nature of the mineral. Fig. 1 is the stereogram for the optic
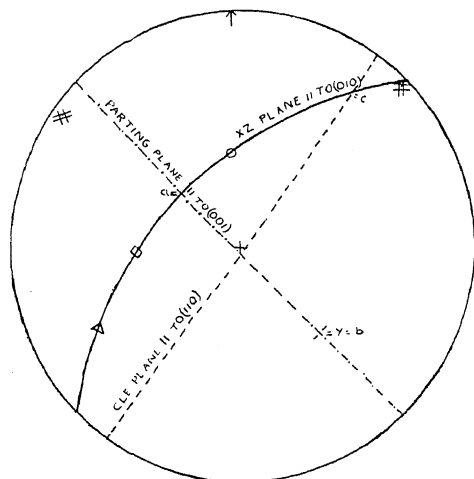
FIG. 1
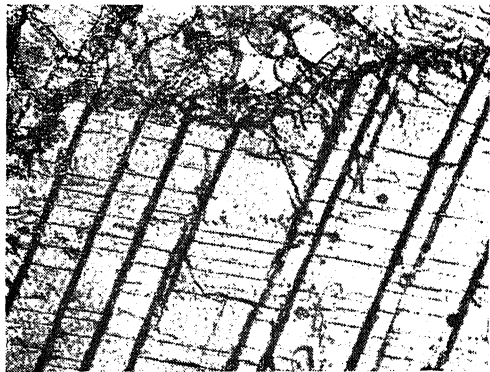
FIG. 2

orientation of the mineral, and Fig. 2 is the photomicrograph of the mineral. The thick continuous lines in Fig. 2 are the (001) parting planes. From the characteristic basal parting the mineral is identified as malacolite, a variety of the diopside-hedenbergite series.

The author offers his grateful thanks to Dr. K. V. Suryanarayana, and Dr. M. G. Chakrapani Naidu for their helpful suggestions.

Department of Geology,   A. KRIPANIDHI.
S.V. University,
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OCCURRENCE OF MEGASPORES, SEEDS, ETC., IN THE TALCHIRS OF INDIA

THE present note records the occurrence of well preserved megaspores, seed cuticles, leaf cuticles and tracheids from the Talchir Stage of the Lower Gondwana formation. The material (collection 1966) consists of typical Talchir Siltstones in a section (about 20-30 ft. thick) along the banks of Johilla River near village Baracaada, north of Birsinghpur, Madhya Pradesh.

The siltstone shows regular alteration of fine sandy and clayey bands. It is strictly in these clay bands that fragmentary fossil impressions are preserved in a haphazard way. The large microfossils were recovered by treating the rock with hydrochloric and hydrofluoric acids. They were picked out and further macerated in nitric acid and cleared in dilute potassium hydroxide solution until they became transparent. In some cases the megaspores were subjected to a strong alkali treatment which gradually dissolved their outer layer and released the inner bodies. Besides these larger microfossils, a rich assemblage of microspores has been recovered from the same material.

A preliminary examination of the microfossils reveals the presence of at least three types of megaspores, two or three types of seed cuticles, a few specimens of seed megaspores and some tracheids with bordered pits.

One of the megaspore types (Fig. 1) has a roundly triangular shape, more or less smooth outline and a distinct trilete mark extending almost up to the periphery. Arcuate ridges can also be noticed. This type has a thin, much folded inner body which shows characteristically a single row of rounded papillæ arranged in a triradiate fashion. One such inner body separated from this type of megaspore is shown in Fig. 2. This megaspore type appears to strongly resemble *Duasporites*.[2]

A few specimens of seed megaspores were found. The specimen in Fig. 3 shows three megaspores in contact. One of them is strikingly larger (? functional) and the other two are smaller (? non-functional).

One type of seed cuticle is shown in Fig. 4. A single layer of integument can be made out which shows longitudinally arranged polygonal cells. The nucellus is large and oval. Some fragments of leaf cuticles have also been found and some of these show stomata and hairs.

Feistmantel[1] reported an equisetaceous stem from the Talchirs of the Johilla valley. Subsequently, interesting assemblages of plant fossils and microspores were described[3,4] from

the Talchir shales of Johilla sequence near Goraia village. It is interesting to note that while the Talchirs at Goraia have yielded mega-fossils and microspores (larger microfossils have not been reported), the same beds at the Barachada section do not contain any identifiable megafossils, but have, on the contrary, yielded only larger microfossils such as megaspores,
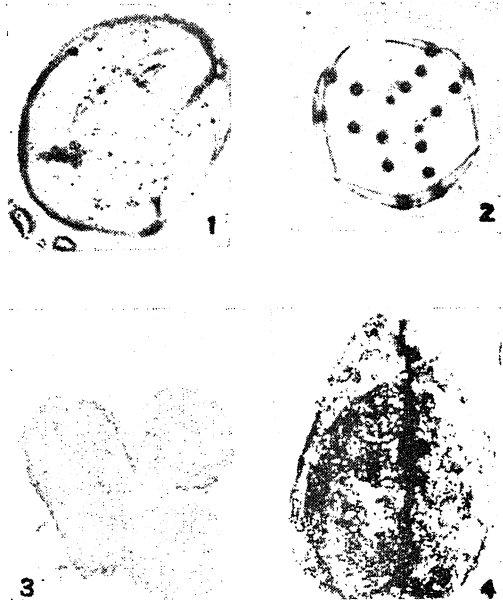
FIGS. 1–4. Fig. 1. Megaspore Type 1, × *ca.* 36. Fig. 2. Inner body from the megaspore Type 1, × 75. Fig. 3. Seed-megaspore Type 1, × 75. Fig. 4. Seed-Cuticle Type 1, × *ca.* 18.

cuticles, etc. Fortunately, however, miospore assemblages are found at both the localities and a comparison suggests striking closeness bet-ween them. Field evidence also seems to favour the view that the sections at Goraia and Barachada may occupy more or less the same stratigraphic position. It is, therefore, likely that the larger microfossils now found at Barachada may represent an extension of the same flora of which the larger elements, (mega-fossils) are preserved in the Goraia section.

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ON THE RELATIONSHIP OF THE RADULA FRACTION AND SHELL LENGTH TO THE TIDAL LEVELS IN THE LIMPET *CELLANA RADIATA* (BORN)

A RELATIONSHIP between the radula fraction namely the length of the radula by the shell length and the vertical tidal levels inhabited by different species of the limpet *Patella* has been previously reported by a few workers.[1,2,5] We carried out some observations to see whether any such correlation is present in the local common limpet *Cellana radiata*.

The collections were made at four tidal levels, Mean High Water Spring (M.H.W.S.), Mean High Water Neap (M.H.W.N.), Mean Sea-Level (M.S.L.) and Mean Low Water Neap (M.L.W.N.). After measuring the length of the shell the foot was cut open and the radula removed along with the buccal mass and measured.

In the 40 samples examined from the four tidal levels a general increase in the average shell length and a decrease in the radula fraction was observed in the animals from the higher to the lower levels. The results are summarised in Table I. A positive and linear relationship between the length of the radula and shell length was also evident. Thus when the shell length was plotted against the radula length the regression line for low water habitat was found to lie above that of the high water habitat (Fig. 1). The regression line may

THE REGRESSION EQUATIONS ARE —

A   M.H W S · YC = 0 3225 X + 3 636
B   M H·W.N   YC = 0.4479 X + 0·876
C. M.S L   YC = 0 5134 X + 2 356
D   M L.W.N   YC = 0.6138 X + 1 487

(WHERE YC IS THE EXPECTED SHELL LENGTH AND X IS THE RADULA LENGTH)
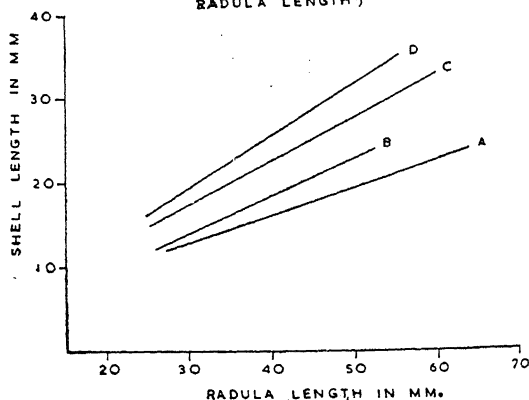
FIG. 1. The regression of shell length on radula length at the four tidal levels.

therefore be helpful in locating the vertical habitat level of the animal.

TABLE I

Summary of radula and shell measurements of Cellana radiata

Tidal level	Number of animals examined	Average shell length (mm.) (C)	Average radula length (mm.) (R)	Radula fraction (R/C)
M.H.W.S. ..	103	19·25	46·50	2·415
M.H.W.N. ..	146	17·46	39·11	2·239
M.S.L. ..	135	23·07	41·60	1·803
M.L.W.N. ..	123	24·83	39·66	1·597

Eslick[3] and Evans[4] attribute the differences in the radula fraction of *Patella vulgata* occupying different tidal zones to the age and size of the animal. Brian and Owen[1] observed a significant difference in the radula fraction in the animals occupying high and low water zones, the former having a higher radula fraction compared with the latter. They attribute this difference to the feeding habits of the animal. Orton[7] has observed that *Patella vulgata* feeds only when it is covered by the tide and Jones[6] found that the animals do not move when they are uncovered by the tide. The feeding time for the animals occupying higher tidal levels is naturally less compared to those at lower levels, which are submerged for longer periods. Brian and Owen[1] conclude that these differences in the lengths of the radula may be a phenotypic character associated with the feeding habits of the animal. Obviously the reduction in the length of the radula in the animals occupying lower levels is attributable to the continuous use of the radula in scraping the food from rock surface which results in its wearing and consequent reduction in the radula fraction in the animals inhabiting the lower levels.

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MORPHOLOGICAL DIVERSITY AND CHROMOSOME NUMBER OF *TRIANTHEMA PORTULACASTRUM* LINN.

CYTOLOGICAL studies have been carried out in a number of polymorphic species.[3-5] The present note describes the meiosis of the two morphological forms showing marked differences in the size of leaves and flowers in *Trianthema portulacastrum* (Fig. 1). Cytological analysis
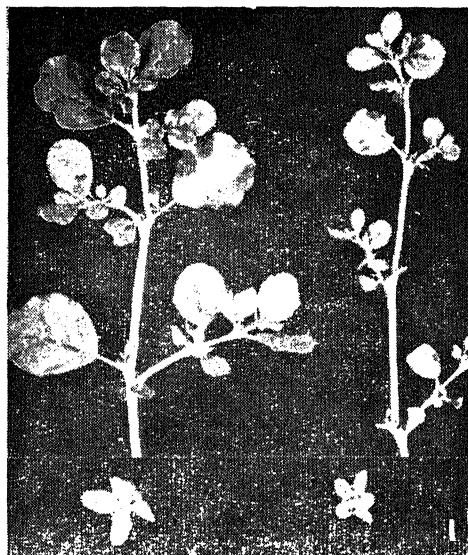
FIG. 1. Twigs and flowers of the two morphological variants.

of the two forms showed the haploid chromosome number to be $n = 13$. This is in confirmation with an earlier report[2] on the chromosome number of the species. The meiosis in both the forms was normal and showed similar details. Complete pairing resulted in thirteen bivalents at diakinesis and metaphase I. The bivalents were usually of the ring type. Presence of two to four univalents due to precocious separation at metaphase I was also observed in some of the cells. Anaphases were normal and showed equal distribution of chromosomes at the two poles.

A number of reports[3-5] have been published in which morphological diversification has been associated with changes in chromosome numbers. Present study shows that the increase in the size of leaves and flowers in *Trianthema portulacastrum* has no correlation with numerical chromosomal differences. Similar results have been reported for *Pluchea lanceolata*.[1]

Department of Botany,   INDU BHALLA.
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XANTHOMONAS ON THESPESIA LAMPAS DALZ. AND GIBS.

WHILE one of the students of the senior author was working on the embryology of *Thespesia lampas* belonging to the family Malvaceæ, it was observed that in the sections of the mature embryo, several round, yellow cavities were present in the cotyledons (Fig. 1). No such cavities were, however, seen in the younger seeds. On further study, it was seen that the cavities were filled with the colonies of the bacterium belonging to the genus *Xanthomonas*.

Cultures were made from the infected mature seeds using the Czapeck-Dox minimal medium. Bacteria grew luxuriantly forming characteristically yellow-coloured round colonies with no distinctive odour. They were stained by carbol fuchsin.

The bacteria are non-filamentous forms and gram-negative and occur singly or in pairs (Fig. 2). The cells are short and rod-shaped, usually with rounded ends but occasionally also with blunt ends. They are capsulated and do not form spores.

It appears that the primary infection of the host starts from the seed where the bacterium remains in the form of a slimy mass. It enters the seed through the micropyle and becomes active when the moisture content of the seed increases.

Xanthomonas has not so far been reported on *Thespesia lampas* as far as the authors are aware. The available literature indicates that the species of *Xanthomonas*-infecting plants belonging to the family Malvaceæ are *Xanthomonas malvacearum* on *Eriodendron anfructosum*[1] and *Gossypium* sp.[2-4]; and

0·05 mm   0·05 mm
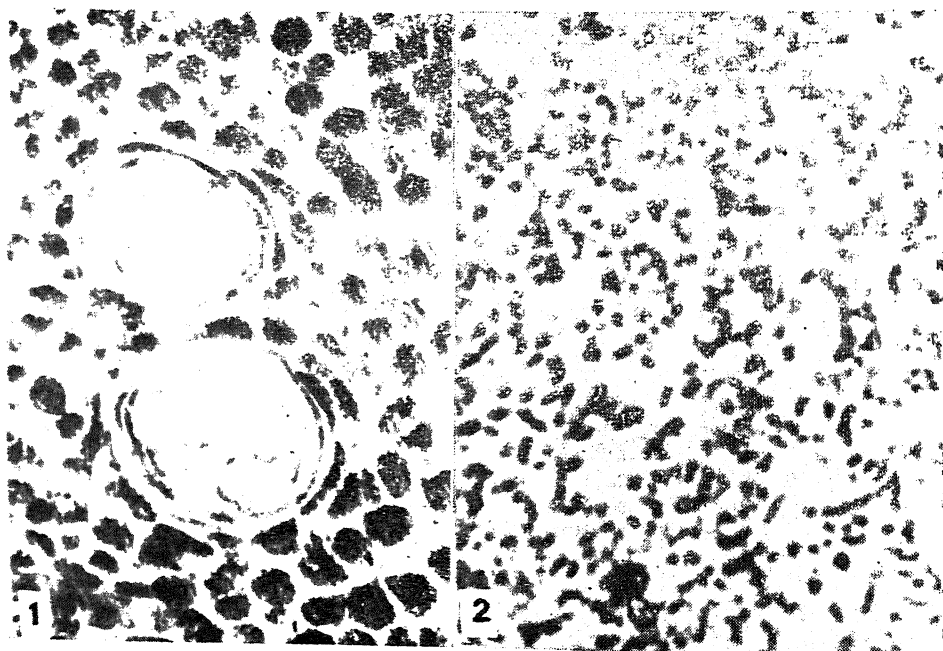
FIGS. 1-2. Fig. 1. T.S. of part of embryo of *Thespesia lampas* through cotyledonary region showing two bacterial colonies, each surrounded by a sheath of the host cells. Fig. 2. *Xanthomonas* from the culture.

Xanthomonas esculenti on *Hibiscus esculentus*[3] and *Xanthomonas* sp. on *Malva* sp.[5] So *Thespesia* will be another addition to the list of plants of the Malvaceæ infected by *Xanthomonas*.

The authors wish to express their sincere thanks to Prof. K. B. Deshpande, Head of Botany Department, Marathwada University, Aurangabad, for valuable suggestions.

Botany Department,   V. R. Dnyansagar.
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VALIDITY OF THE GENUS *SALMONOMYCES* CHIDD. (ERYSIPHACEAE)

In a recent paper on African species of *Uncinula*, in Deighton and Pirozynski (1965),[1] Pirozynski considers the genus *Salmonomyces* Chidd. synonymous with the genus *Uncinula* reducing *Salmonomyces kamatii* Chidd. to synonymy with *Uncinula acalyphœ* Tai. Tai (1946)[2] determined the mildew collected by him on *Acalypha brachystachya* in China as a *Uncinula* and named it *U. acalyphœ* Tai. This determination was based on a character of perithecial appendages, which Tai himself described as *"rarely uncinate or helicoid"*. Such a determination based on the rare occurrence of characters in a fungus raises important taxonomic problems. Such emphasis on the occurrence of rare characters if accepted for determining taxa is likely to lead to confusion.

The genus *Salmonomyces* Chidd. was established on the basis of distinctive characters of the perithecial appendages which are stiff, rigid, densely arranged, with a conspicuous swollen base and constriction, typically acicular and deep brown. The normal absence of uncinate or helicoid tips in the appendages and of bulbous bases distinguishes it from the genera *Erysiphe* and *Uncinula* on the one hand, and *Phyllactinia* on the other. This fungus, it may be stated, has been collected here over a period of six years in all stages of development and on two additional species of *Acalypha*, without exhibiting any marked variations in the character of appendages, as originally

described by Chiddarwar (1959).[3] In none of the numerous collections made in nature as well as on hosts maintained in the plant house at Poona under varying conditions of environment, did this non-uncinate character of the appendages ever show any significant variation or modification. This justifies the establishment of the genus *Salmonomyces* as distinct from any other known genera of the Erysiphaceæ.
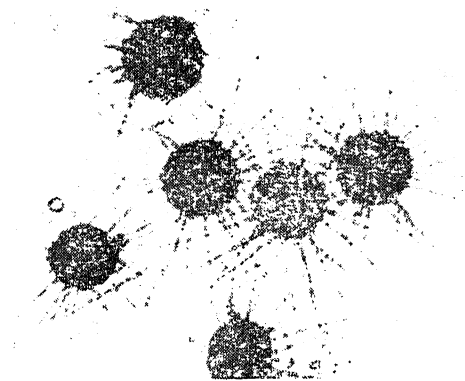
Fig. 1. Photomicrograph of perithecia of *Salmonomyces kamatii* Chidd.

It may be added that concomitant assemblage of associated characters, *viz.*, (1) swollen bases, (2) constrictions and acicular nature of the perithecial appendages obtained in the genus *Salmonomyces* Chidd. was entirely absent in *Uncinula acalyphœ* Tai where the appendages are described as uniformly wide, not acicular and without any swollen bases and constrictions characteristic of the genus *Salmonomyces*.

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STUDIES ON RADIATION-INDUCED FRAGMENTS AND STRUCTURAL REARRANGEMENT OF CHROMOSOMES IN *CORIANDRUM SATIVUM*

Seeds of *Coriandrum sativum* var. Banda 32 were irradiated at 5,000, 10,000, 15,000; 20,000; 25,000, 27,500 and 30,000 rontgens at I.A.R.I., New Delhi. With the increase in dose the percentage of germination decreases. In

5,000 r set T 28 was taller than the average height of the controls. Three plants T 51 in 10,000 r and T 69, T 78 in 15,000 r were late flowering. Out of these T 78 was much taller than the controls. Morphologically some of these variants showed distinct changes. In 25,000 r T 110 was small, had thick distorted leaves like the polyploids (Joshi and Raghuvanshi, 1965)[1] with poor branching and delayed flowering. In the same set T 118 was also small in height, T 158 (30,000 r) had fairly normal height with thick leaves and few branches. The upper leaves were less finely dissected.

Cytology of T 110 presented interesting features. Its chromosome number was 22, which is the diploid number for this species. Besides univalents it showed quadrivalent (Figs. 1, 3)
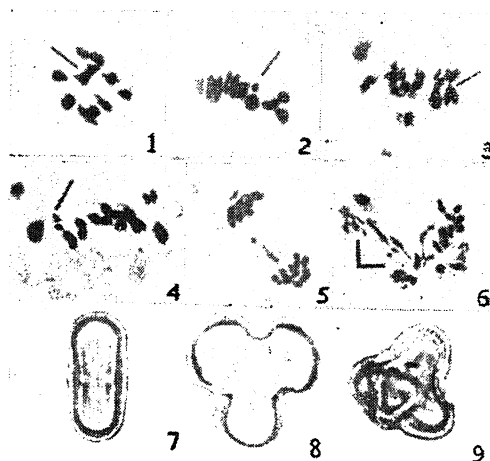
FIGS. 1-9. Fig. 1. A PMC showing a quadrivalent. Fig. 2. M. I with a fragment. Fig. 3. M. I with quadrivalent. Fig. 4. Precocious division of a univalent on the first metaphase plate. Fig. 5. Bridge fragment configuration at A. I. Fig. 6. Dividing fragments at A. II. Fig. 7. Normal control type grain. Fig. 8. Triradiate (Type E) grain. Fig. 9. Tetraradiate (Type G) grain.

and bridge-fragment (Fig. 5) configurations. Thus irradiation induced structural rearrangement in the chromosomes of *Coriandrum sativum*. The maximum number of univalents observed in one PMC was 12. Precocious division of a univalent at M.I was observed in a few cells (Fig. 4). Some cells, besides the normal chromosome complements, had fragments (Fig. 2) which in some cases underwent division (Fig. 6). This division of the fragment and separation towards the poles clearly indicated the presence and normal functioning of the centromeres.

T 158 (30,000 r) was of fairly normal height with thick, less dissected leaves. Cytologically pairing of its chromosomes was regular with fragments in some PMCs. Anaphase was marked by bridges and breakdown of the spindle in some cells. Microspindle was observed at M. II. Besides these other plants showed anomalies like precocious separation of chromosomes, bivalents off the plate at M. I, bridges and strays at A. I, micronuclei at T. I, strays at M. II, bridges and laggards at A. II and T. II. Another feature of interest is the presence of few variable pollen grains in the treated plants. Their frequency, however, was very low in comparison to the colchicine-gammexane treatment (Joshi and Raghuvanshi 1965)[1] but the pattern of variability was the same (Figs. 7-9). The presence of variable grains in irradiated plants indicated that it is not only the chemicals which cause pollen variability in Umbellifers but similar pollen shapes could be induced by irradiation also.

Cytogenetics Laboratory,   SHEILA JOSHI.
Department of Botany,   S. S. RAGHUVANSHI.
University of Lucknow,
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CHANGES IN AMINO-ACID CONTENT OF *AMARANTHUS TRICOLOR* LEAVES INFECTED WITH *ALTERNARIA* SP.

Amaranthus tricolor L. is grown as an ornamental plant in many parts of India and its duration is about 120 days from seed to seed. While the older leaves are purplish-green the new flush put forth after about 100 days differentiate into two distinct halves with clear-cut margin, the upper half being purplish to dark green and the lower reddish-pink. Rangaswami[1] observed that lower reddish half of the leaf blade is commonly infected by a leaf spot disease, the upper greenish half as well as other purplish-green older leaves being free from infection by the disease. Balaguru who studied the disease in detail reported that the pathogen appeared to be a new species of *Alternaria*, and also in his inoculation experiments he failed to obtain successful infection of the green parts of the leaf blades, whereas there was ready infection of the reddish parts of

the leaf blade by the pathogen. The present report concerns the studies on the changes caused by the pathogen in the amino-acid content of the red and green portions of the leaf blades of *A. tricolor*.

A. tricolor plants were raised from healthy seeds, and were maintained under controlled conditions in the green house. When about 100 days old the leaves were surface-sterilized, and inoculated with a pure culture of *Alternaria* sp., following the usual procedure. The inoculated and check plants were maintained under humid conditions in the green house. In about four days after inoculation, disease symptoms in the form of water-soaked lesions appeared in the reddish leaf blades, but not on the green ones. The water-soaked lesions turned into characteristic *Alternaria* spots in about 8 days. The pathogen could be readily isolated from these spots and on comparison it was found identical with the inoculum.

About ten days after inoculation the leaves, which were differentiated into green and red portions, were removed from the plants and the two portions cut and separated. Similar leaves, which were inoculated and infected with *Alternaria* leaf spots, were also removed and the green and red portions separated. The leaf bits were then cut into small pieces and extracted in 80% boiling ethanol over a water-bath for five minutes. The extraction process was repeated twice, the extract filtered through cheese cloth, and the final volume adjusted to represent 5 ml. of 80% ethanol for every gm. of the leaf tissue. The extracts were further concentrated under reduced pressure to about 1/10 the volume and the concentrates were taken up for estimating the amino-acid content.

The qualitative assay of the amino-acid in the extracts was carried out by the two-dimensional paper chromatographic technique, using *n*-butanol-acetic acid-water (4 : 1 : 1) as the first solvent and phenol : water (4 : 1) as the second. The chromatogram was developed with ninhydrin spray (0·5 gm. ninhydrin in 95 ml. acetone and 5 ml. water). The amino-acids were identified with known standards and were estimated quantitatively by the method of Demetriades.[3] The results are summarized in Table I.

Both the red and green healthy tissues contained ten amino-acids each, and their concentration varied only slightly. When the leaves

TABLE I

Amino-acids in the healthy and diseased leaves of Amaranthus tricolor
(mg./gm. oven dry weight)

Amino-acid	Healthy leaf		Diseased leaf	
	Red tissue	Green tissue	Red tissue	Green tissue
Phenylalanine ..	0·044	0·048	0·020	0·023
Valine ..	0·098	0·085	0·107	0·098
Methionine ..	0·117	0·125	0·153	0·145
Tryptophan ..	0·272	0·273	0·196	0·198
Tyrosine ..	0·141	0·160	0·163	0·158
Alanine ..	0·035	0·037	0·039	0·039
Threonine ..	0·399	0·414	0·318	0·364
Serine ..	0·066	0·073	0·103	0·073
Asparagine ..	0·173	0·166	0·185	0·179
Arginine .	0·085	0·066	0·121	0·106

were infected with *Alternaria* sp., the quantity of serine and arginine increased in the susceptible portion of the leaf, *viz.*, the red tissues, whereas in the green tissues arginine only increased, while the tryptophan and threonine got reduced. Changes in amino-acids following fungal infection of some other plant tissues have been reported by other workers.[4-6] The possibility of amino-acids being transported to the site of infection and subsequent utilization by the pathogen has been suggested by McCombs and Winstead[7] and Rangaswami and Natarajan.[5] However, the relationship of changes in the amino-acid concentrations of the green and red tissues of the diseased leaf and resistance and susceptible mechanism to infection by *Alternaria* sp. remains to be understood.

Microbiology Laboratory,   D. CHANDRAMOHAN.
Faculty of Agriculture,   A. MAHADEVAN.
Annamalai University,   G. RANGASWAMI.*
Annamalainagar, Madras,
August 16, 1966.

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* Present address : University of Agricultural Sciences, Bangalore 24.

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REVIEWS AND NOTICES OF BOOKS

Infrared Spectra of Cellulose and Its Derivatives. By R. G. Zhbankov. Edited by Academician B. I. Stepanov. Translated from Russian by A. B. Densham. (Consultants Bureau, New York), 1966. Pp. xiv + 333. Price $ 16.00.

This book contains a systematic discussion of the infrared spectra of an important natural polymer—cellulose—and its derivatives. The infrared spectra of the main classes of cellulose derivatives are described and interpreted, as are those of model compounds such as mono-, di-, and trisaccharides. Considerable attention is given to technical problems involved in obtaining infrared spectra of fibrous cellulose materials, and to the analytical possibilities of infrared spectroscopy in cellulose chemistry and allied fields.

Spectra and tables are given in a 130-page appendix which will aid researchers in the rapid preliminary appraisal of the origin of individual absorption bands appearing in the infrared spectra of cellulose materials, and in the choice of spectral region for the determination of particular atomic groups.　　**C. V. R.**

Advances in Immunology (Vol. 5). Edited by F. J. Dixon Jr. and J. H. Humphrey. (Academic Press, New York and London), 1966. Pp. x + 445. Price $ 16.00.

The fifth volume of this serial publication reviews several subjects central to the development of immunology. As our understanding of the immune response increases and its general characteristics begin to be defined in terms applicable to other genetic and metabolic events, its unusual or aberrant aspects can be viewed in some perspective. Among the unusual aspects of immunology are the existence of apparently unsolicited or natural antibodies on one hand and auto-antibodies with their frequently associated pathological processes on the other.

The titles of the chapters contained in this volume are as follows : Natural Antibodies and the Immune Response, by Stephen V. Boyden ; Immunological Studies with Synthetic Polypeptides, by Michael Sela ; Experimental Allergic Encephalomyelitis and Autoimmune Disease, by Philip Y. Paterson ; The Immunology of Insulin, by C. G. Pope ; Tissue-Specific Antigens, by D. C. Dumonde.　　**C. V. R.**

Instrumentation for High Speed Plasma Flow. By Allen E. Fuhs. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1965. Pp. xvi + 180. Price $ 19.50.

In this monograph Dr. Fuhs discusses principally electrodeless instruments which use magnetic or electromagnetic fields to probe the plasma. Electrostatic probes are briefly surveyed, and the features of different plasma flows, *e.g.*, the sheath surrounding a reentry vehicle, rocket exhaust, ballistic ranges and MHD generators, are related to the instrumentation theory and design. Instruments for determining both macroscopic and microscopic plasma properties are described in detail with liberal use of figures and illustrations, and regimes where different measuring devices are applicable are delineated. Sufficient theoretical background is developed so that the reader can use the concepts and results to select and design instruments for his particular needs. Included are two useful tables, of Magnetohydrodynamics and Plasma Formulæ and Constants and Conversion Factors.

The contents of this book are : Development of the Equations ; Magnetic Field Balance ; Typical Ionized Gas Flows and Instrumentation Applications ; Plasma Properties Measured by Inductive Flow Instrument ; Average and Profile σU Transducers ; Transducers for Rocket Exhausts, Arc Plasma Jets and Axisymmetric Reentry Vehicles ; Transducers for Transient Flows ; Shock Tubes and Ballistic Ranges ; Flow Angle Indicator ; Average Electron Collision Frequency Instrument ; Turbulence and Velocity ; Steady Magnetic Field Instruments for Steady Flows ; Other Diagnostic Instruments ; Description of MHD Profile Meter and Transition Indicator for a Reentry Vehicle ; Design Features of Axial Flow Transducer for Rocket Exhaust ; Author Index ; Subject Index ; Table of Magnetohydrodynamics and Plasma Formulæ ; Table of Constants and Conversion Factors.　　**C. V. R.**

Scientific Approach. By Prof. J. T. Davies. (Academic Press, New York and London), 1965. Pp. x + 100. Price 32 *sh.* 6 *d.*

Where do new ideas come from ? How much confidence do we have in scientific theories ? How should one tackle a new problem "scientifi-

cally" ? What can science achieve, and what are its limitations ?

The *Scientific Approach,* written by winner of two international prizes for contributions to the subject, answers these and many other philosophical questions in terms comprehensible both to the humanist and to the scientist. Though it contains many examples, drawn from both the ancient and modern worlds, it is far from being a mere collection of scientific facts and laws. Rather does it emphasize how man's interpretation of Nature has developed since Classical times, how his philosophy of science changed radically at the beginning of the seventeenth century, how it has blossomed into the modern, internationally accepted, scientific method.

A bold new unification has a poetic beauty whether one achieves it in words, in paint or in a scientific theory. Creative thinking is thus common to the arts and the sciences. This, together with philosophy, the interpretation of history, the Classical views of Nature, modern scientific planning and economics, span the gulf between the "Two Cultures". An understanding of scientific method, presented here without a mass of technical details, provides a common language through which scientists and non-scientists alike can examine more thoughtfully the planning and interpretation of experiments.

C. V. R.

Advances in Protein Chemistry (Vol. 21). Edited by C. B. Anfinsen, Jr., M. L. Anson, John T. Edsall and Frederic M. Richards. (Academic Press, New York and London), 1966. Pp. viii + 451. Price $ 16.75.

Volume 21 of this well-known series contains the following chapters : Naturally Occurring Peptides, by S. G. Waley ; Cytochrome *c*, by E. Margoliash and A. Schejter ; Hydrogen Exchange in Proteins, by Aase Hvidt and Sigurd O. Nielsen ; Selenium Derivatives in Proteins, by J. Jauregui-Adell.

C. V. R.

The Dynamics of the Upper Ocean. By O. M. Phillips. (Cambridge University Press), 1966. Pp: vii + 261: Price $ 11.50 in U.S.A., 60 *sh*: net in U.K.

Professor Phillips gives a connected account of the three types of motion—surface waves, internal waves and turbulence—that occur in the upper ocean, their generation and their interrelationships. These motions provide the means for the exchange of matter, energy and momentum between the atmosphere and the underlying deep ocean ; exchanges which, on the global scale, produce the general circulation pattern in the oceans and are among the most important factors in determining the world-wide distribution of climate. A proper under-standing of the behaviour of the upper ocean is at the heart of these larger questions.

The book, which was awarded an Adams prize in the University of Cambridge, is the first monograph on these topics. Its purpose is to provide for oceanographers the best available insight into questions involving the air-sea interface and its influence on oceanic motions, and to interest applied mathematicians in the challenging problems which the subject presents. It embodies the results of recent research, including some which has not previously been published.

C. V. R.

Semiconductor Circuits (Theory, Design and Experiment). By J. R. Abrahams and G. J. Pridham. (Pergamon Press, Headington Hill Hall, Oxford), Pp. 310. Price 30 *sh.* net.

The book, written by two teachers of con-siderable experience in transistor circuitry, is chiefly intended for engineering undergraduates and senior technicians as a practical guide to design and modify circuits involving transistors and related semiconductor devices. The book is in three parts : the first dealing with the theory of semiconductors, the second with design of circuits, chiefly for *pnp* transistors, and the third devoted to some 20 demonstration experi-ments.

A. S. G.

Stories from Science (Books 3 and 4). By A. Sutcliffe and A. P. D. Sutcliffe. (Cambridge University Press, Bently House, 200, Euston Road, London, N.W. 1), Pp. 128 and 120. Price : Library Edition 15 *sh.* each ; School Edition 9 *sh.* 6 *d.* non net.

These instructive and fascinating books have emerged from the senior author's hobby as a young science master in Cambridge, of collecting stories of unusual incidents or chance occur-rences in science and engineering to add interest to his teaching. Each chapter is connected with an important discovery or scientific principle, and is associated with some historical incident. The information is authentic and references to original sources are given.

Books 3 and 4 are devoted to the life sciences, biology and medicine. Some of the 22 chapters in Book 3 are : The First Use of Anæsthetics ; Stories of Smallpox ; The Accidental Discovery of Penicillin ; A Door Stop and Phosphate

It seems

GEOMAGNETIC EFFECTS ASSOCIATED WITH ACTIVE SOLAR REGIONS

B. N. BHARGAVA

Colaba Observatory, Bombay-5

THE relationship between solar activity and terrestrial magnetic and associated auroral, ionospheric and cosmic ray effects has been intensively investigated in the last few decades. During the IGY and subsequent years there has been a substantial addition to our knowledge of solar wave and particle emission, effects of conditions in the interplanetary space on the

magnetic substorms, auroral substorms and sudden influx of energetic particles in the magnetosphere are the main features of disturbed conditions of the magnetosphere. The origin on the sun and the nature of several types of particles responsible for terrestrial magnetic and related effects are given in Table I.

TABLE I

Particle radiation from sun

Solar activity	Nature of emitted particles	Velocity	Travel time of particles	Nature of associated solar radio events	Terrestrial magnetic and associated effects
Quiet sun ..	Slow particles (quiet-sun wind composed of protons and electrons)	300– 350 km./s.	Several days	..	Deformation of terrestrial magnetosphere and confining it to a cavity, red polar cap glow, perpetual agitation of the magnetic field in the polar regions, maintenance, in winter, of F region in polar caps
M-regions, coronal streamers	Slow particles	700 km./s.	2–4 days	..	Recurrent moderate magnetic storms during declining part of the solar cycle
Important flares concentrated in the northern solar hemisphere; flares located close to the central meridian and in magnetically complex spot regions	Storm plasma (protons and electrons)	1,000-2,000 km./s.	12–72 hrs.	Types II, III and IV	Great SC storms, Forebush decrease, ionospheric storms, increase in cosmic rays at middle and low latitudes (decrease of cut-off rigidities of incoming cosmic rays because of depression of geomagnetic field)
Exceptionally important (CR) flares. Flares associated with ground level increase of cosmic rays concentrated in western solar hemisphere	Energetic protons	100,000 km./s.	15 mts. to a few hrs. (delay times longer for events close to peak of solar cycle)	Types II, III and IV	Polar cap absorption, ground level increase of cosmic rays limited to higher latitudes by prevailing geomagnetic cut-off

propagation of solar plasma and the interaction of this plasma with the earth's magnetic field. In a recent review, Cole[1] has discussed the phenomenon of magnetic storms in terms of 'quiet' and 'disturbed' conditions of the magnetosphere. The 'quiet' condition is marked by red auroral arcs, green (λ 5577) coloration of auroras and maintenance of ionospheric F region in winter over the polar caps in the absence of solar ionizing radiation. Polar

2. STEADY SOLAR WIND

The terrestrial magnetic field, if it existed in vacuum, could be approximated by a dipole field. In reality, this field is immersed in a time-variable flux of solar wind. Some years ago Biermann[2] showed that the behaviour of cometary tails could be accounted for by postulating that a stream of high-speed particles was being continuously emitted from the sun. Recent space probes have measured the ion

flux and energy and have confirmed the existence of an outward flow of plasma. The solar wind penetrates to a distance r where the magnetic pressure inside the boundary is equal to the impact pressure of the wind :

$$\frac{B^2}{8\pi} = 2\, Nmv^2 \cos\theta,$$

where B is the value of the field at the boundary, N, m and v are the number per cm.^{3}, mass and velocity of particles respectively and θ is the angle between the incident flux and the normal to the surface. If B_0 is the field at the earth's surface, R_e the radius of the earth and P the plasma pressure, the radius r of the geomagnetic 'cavity' at the equator is given by

$$r = 1\cdot37 \left[\frac{B_0^2}{8\pi P} \right]^{\frac{1}{6}} R_e$$

Using measurements made by explorer 10, the boundary should be located at about 9·6 R_e. The shape of the cavity under constant plasma pressure has been discussed in detail by Slutz.[3]

Deep space probes have indicated two principal regions, the magnetosphere (geomagnetic cavity) and the transition region called the magnetopause. Observations from IMP-I satellite show that on the anti-solar side the tail of the magnetosphere may extend to a considerable distance, perhaps several A.U. (Astronomical Unit). In the sun-earth line the magnetic field is relatively stable—both in magnitude and in direction out to about 10 R_e. This is followed by a region, about a few earth radii deep, in which the magnetic field is disturbed. This turbulent magnetopause has been identified as the standing shock layer in front of the cavity. Beyond this region the magnetic field is constant (4 to 7γ) and is the interplanetary magnetic field. Preliminary results of more recent measurements of interplanetary field on Pioneer 6 space probe have been recently published by Ness *et al*.[4]

The perpetual agitation of the magnetic field in the polar regions, associated with the influx of solar wind and consequent disturbance of lines of force meeting the earth within 20° to 25° of the geomagnetic poles, provides a direct geophysical evidence of quiet-sun wind.

3. Flare-Associated Activity

Important flares are generally accompanied after 12 to 72 hours by severe storms.[5] There are, however, many class 3 and 3$^+$ flares not followed by storms and severe storms not preceded by important flares. Extensive work has been done in the past decade to identify

the optical, radio and other characteristics of storm generating flares. Bell[6] showed that source flares for great storms were concentrated towards the central part of the solar disc and showed a rather unexpected concentration in the northern solar hemisphere. Bell also found that storm-generating flares showed a conspicuous occurrence in magnetically complex spots (γ and $\beta\gamma$) rather than in unipolar (α) or bipolar (β) groups. A strong association has been shown to exist between flares with radio bursts of spectral type IV (continuum radiation) and magnetic storms. Further, the probability of a flare being followed by a storm was still greater[7] when both type IV and type II (slow drift) bursts are present. Wild[8] has suggested that the presence of type IV radiation may be an indication of the amount of matter transported from the flare by type II phase of the disturbance.

4. Particle Emission from Flares and Terrestrial Magnetic Disturbances

Within a day or two (with an average of about 22 hrs. for class 3$^+$ flares and 34 hrs. for class 3 flares) some, but not all, flares produce a sudden increase of 20 to 30 γ in the horizontal force which is observed, simultaneously, all over the world. The sudden commencement owes its origin to the impact of solar plasma consisting of protons and some electrons in the KeV range and moving with a velocity of 1,000 to 2,000 km./sec. The compression is believed to be communicated to earth's surface through the action of hydromagnetic waves. Within hours, the magnetic field drops and remains subnormal during next one or two days (the main phase). This phase, during which the field remains in varying degrees of agitation, is followed by recovery with a half life of about 5 to 10 hours.

A small proportion of flares, usually of importance 3 and 3$^+$ emit energetic particles responsible for Polar Cap Absorption (PCA) and increase of cosmic rays at ground level (GLE). The less energetic (MeV range) particles are detected by riometers and the more energetic ones (BeV range) by neutron monitors. The emission of these energetic particles is generally accompanied by type II (slow drift) and type IV (continuum) radiation. Cosmic ray flares associated with emission of particles in BeV range usually appear in the western solar hemisphere and avoid the peak of solar activity. The delay times of particles from flares nearer to peak solar activity are considerably higher. The phenomena of accele-

ration of the protons, their trapping and release has been extensively studied during the IGY and subsequent years. In a recent investigation,[9] geomagnetic sudden commencement amplitudes have been examined in relation to optical, energetic particle and radio characteristics of source flares and the results have been utilized to identify about 50 cosmic ray flares during solar cycles 12-18.

Reviews of theories of magnetic storms and auroras have appeared frequently in literature; the most recent one is by Cole.[1] Cole has also observed that the method of analysis of magnetic storms with SC as the origin of time has no physical basis and that the time of enhanced geomagnetic noise as an origin of time is considered to have physical validity.

5. ULTRAVIOLET AND X-RAY EMISSION AND SIMULTANEOUS EFFECTS

The more important and centrally located flares give rise to magnetic crochet (SFE) seen as a temporary increase superposed on the normal daily variation. The phenomenon, confined to within 70° of the sub-solar point, is caused by the photo-ionization by X-rays and far ultraviolet and resulting increase in the electrical conductivity of the ionosphere between 60 and 100 km. Recent studies indicate that X-rays of 1 to 20 Å from the hot coronal regions are more efficient ionizing agents in the region of 60 km. The related ionospheric effects are the SWF (increased absorption of obliquely reflected short-wave signal); SEA and SES, sudden enhancement of low frequency signals from distant thunderstorms and long wave signals (increased reflectivity of D region); SPA, sudden phase anomaly (decreased reflection height and consequent phase change of sky-wave propagated signal; SFD, sudden frequency deviation (change in the frequency of reflected high-frequency signal) and SCNA, sudden cosmic noise absorption (increased absorption of galactic noise in the lower ionosphere). Excellent survey of the flare X radiation including results of rocket and satellite observations has been made in several recent review articles.[10,11]

6. SOLAR ACTIVITY AND RECURRENT MAGNETIC STORMS

Magnetic activity during the declining part of the solar cycle is composed of weak storms which have a tendency to recur at intervals of about 27 days, the rotational period of the sun. No visible solar activity can be associated with recurrent magnetic activity. Bright coronal regions,[12] unipolar magnetic fields,[13] filaments,[14] chromospheric plages[15] and bright 21 cm. solar regions[16] have been associated with recurrent storms. The regions emitting plasma responsible for recurrent storms have been called M-regions by Julius Bartels. The phenomena of recurrent storms, M-regions and solar wind have been reviewed by Piddington,[17] Allen[18] and Hirshberg.[19] Several hypotheses for explaining principal features of recurrent storms have been proposed and these have been discussed recently by Obayashi.[20] Mariner II observations[21] during the later part of 1962 indicate a velocity of about 700 km./sec. and a strong 27-day recurrence for the plasma originating from the M-regions.

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CHEMICAL EXAMINATION OF *ADIANTUM VENUSTUM* Don.

S. RANGASWAMI AND R. THANU IYER

Department of Chemistry, University of Delhi, Delhi-7

IN recent years increasing attention has been paid to the chemistry of ferns. *Adiantum venustum* is a fern of small size growing in the Himalayan region, regarding which no chemical information is available so far. Our results with this material purchased from a local dealer and identified in the Botany Department of this University are given below.

The material was extracted with petroleum ether, ether and ethyl alcohol in succession. The residue from the petroleum ether extract, a pale yellow solid, was chromatographed on neutral alumina. Petroleum ether eluted a colourless solid, which crystallised from petroleum ether-acetone as glistening plates, m.p. 229–30°. Formula $C_{30}H_{50}$,* $[\alpha]_D$† $+57 \cdot 6°$. Liebermann Burchard reaction: positive (pink); tetranitromethane reaction: positive. The I.R. spectrum showed bands at 1170 cm.$^{-1}$ (isopropyl) and 850 and 790 cm.$^{-1}$ (trisubstituted double bond). The N.M.R. spectrum showed signals at $5 \cdot 25 \delta$ (olefinic proton) and $1 \cdot 64 \delta$ (methyl group on double bond). Oxidation with CrO_3 in acetic acid gave on $\alpha\beta$-unsaturated ketone (DNP reaction and U.V. absorption at 245 mμ). These led to the conclusion that the hydrocarbon is 3-filicene first isolated from *Adiantum monochlamys* by Ageta et al.[1]

In the same chromatography petroleum ether : benzene (7:3) eluted a second substance crystallising as glistening needles from benzene-petroleum ether, m.p. 226°, formula $C_{29}H_{48}O$, $[\alpha]_D \pm 0°$. Liebermann-Burchard reaction: positive; tetranitromethane reaction: negative. It had I.R. absorptions at 1376 and 1364 cm.$^{-1}$ (gem-dimethyl group), 1470 cm.$^{-1}$ (methylene groups) and 1706 cm.$^{-1}$ (carbonyl). The N.M.R. spectrum showed a sharp signal at $2 \cdot 18 \delta$ (–CO-CH$_3$ group). It formed a benzylidene derivative, m.p. 268–70°, $[\alpha]_D$ $+49°$, which on ozonolysis gave the nor-acid $C_{28}H_{46}O_2$ (–COOH in place of –COCH$_3$), m.p. 310–12°. This acid was obtained also by the oxidation of the parent ketone with NaOBr (m.p., mixed m.p. and T.L.C.). A search through the literature showed that the parent ketone could be isoadiantone described by Berti et al.[2] For further confirmation, it was reduced with LiAlH$_4$ and with

NaBH$_4$. With each reagent, a mixture of two isomeric alcohols $C_{29}H_{50}O$, m.p. 189–90° and 197–98° was obtained and these gave acetates, m.p. 197–98° and 205–06° respectively. Oxidation of each alcohol with CrO_3 in pyridine gave back the parent ketone.

In the same chromatography mentioned above, petroleum ether-benzene (1:3) eluted a third crystalline solid, m.p. 280–300° which, in spite of its large melting range, was homogeneous according to T.L.C. $[\alpha]_D$ $+13°$. Formula $C_{29}H_{48}O_2$, Liebermann-Burchard reaction: positive (pink); tetranitromethane reaction: negative. I.R. absorptions at 1380 and 1350 cm.$^{-1}$ (gem-dimethyl) and 1450 cm.$^{-1}$ (methylene) confirmed its triterpenoid nature. The bands at 3492 and 1307 cm.$^{-1}$ showed the presence of hydroxyl group, but it resisted acetylation and may be tertiary. The absorption at 1711 cm.$^{-1}$ showed the presence of a six-membered ring ketone. The compound formed a DNP derivative, m.p. above 315° and gave a positive Zimmermann colour reaction indicating the presence of a –CH$_2$–CO– group. The iodoform reaction was negative and the compound was recovered unchanged after treatment with NaOBr for 10 hours (absence of –COCH$_3$). Its N.M.R. spectrum showed general similarity to that of isoadiantone in the region 0·74 to 1·06 δ. But the following differences were conspicuous. The sharp signal at $2 \cdot 18 \delta$ present in the spectrum of isoadiantone (–COCH$_3$) was absent in that of the new compound, while two new signals not present in the spectrum of isoadiantone were present in that of the new compound. These were (1) a multiplet centred at $2 \cdot 47 \delta$ and integrating to ca 2 protons which showed the presence of a –COCH$_2$– group split by neighbouring protons, and (2) a fairly sharp signal at $1 \cdot 27 \delta$ integrating to ca 3 protons (CH$_3$–C–OH). On the basis of these data, the structure (A) is tentatively suggested for it. Further work to verify this is in progress.
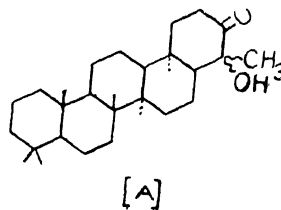
[A]

Since according to Berti *et al.*[2] adiantone isomerises to isoadiantone with acids or alkalies or on chromatography over alumina, in another experiment the petroleum ether extract of the fern was chromatographed on silica gel instead of alumina. In this chromatogram the ketone, m.p. 226°, $[\alpha]_D$ 0° was not obtained; instead another substance, m.p. 218°, $C_{29}H_{48}O$, $[\alpha]_D + 96°$ was got. A mixture of the two substances melted at 180–85°. The substance of m.p. 218° underwent isomerisation to the ketone, m.p. 226° (mixed m.p.) on treatment with hot alkali or hot mineral acid. This compound of m.p. 218° should therefore be adiantone.

The ether extract of the plant yielded a gummy residue which was saponified with potash in benzene-alcohol solution. The unsaponifiable matter, a red semi-solid, was chromatographed on neutral alumina. Benzene : chloroform (1 : 1) eluted a reddish-yellow substance which crystallised from benzene-methanol as reddish-yellow plates, m.p. 173–75°. It gave a violet colour with conc. H_2SO_4 and a blue colour with $SbCl_3$ in chloroform. It showed absorption in the visible region as below : 497, 467 mμ (CS_2), 480, 450 mμ (C_6H_6), 478, 449 mμ ($CHCl_3$). These indicate that it may be α-carotene monoepoxide.[3]

The alcoholic extract was concentrated to low bulk and the largely aqueous residue extracted successively with petroleum ether, benzene, ether and ethyl acetate. The ethyl-acetate extract was concentrated and diluted with petroleum ether. The yellow solid that separated was a mixture. It was chromatographed on silica gel and eluted with dry solvents. Benzene : ethyl acetate (3 : 1) eluted a colourless substance, m.p. 275–80° giving a red colour with hot alcoholic HCl (leucoanthocyanidin). Subsequent elution with benzene : ethyl acetate (1 : 3) yielded a bright yellow solid which gave a ferric reaction and a red colour with Mg-HCl (flavonoids).

The leucoanthocyanidin was refluxed with 10% ethanolic HCl and the mixture, after removal of alcohol and replacement by water, was extracted with ether, ethyl acetate and amyl alcohol in succession. The first two extracts yielded nothing. The flavylium salt contained in the amyl alcohol extract was transferred into 0·01% aqueous HCl in the usual manner and utilised for obtaining the pure flavylium salt by means of preparative paper chromatography. The flavylium salt was eluted from the paper chromatogram with 0·01% alcoholic HCl and the rose-red solution used for spectral analysis. It had an absorption maximum at 533 mμ which was unaffected by the addition of $AlCl_3$. These showed that the parent leucoanthocyanidin was leucopelargonidin.

The flavoniod fraction mentioned above was found to be glycosidic in nature (Molisch's test). Thin layer chromatography of the aglycone (obtained by the hydrolysis of the glycoside with 7% H_2SO_4) showed the presence of two aglycones. Attempts to separate the glycosidic mixture by column chromatography on silica gel, by preparative T.L.C. and by preparative paper chromatography, all failed. The glycosidic mixture was therefore used as such for further study. Examination of the sugar obtained by the hydrolysis using paper chromatography showed the presence of only one sugar, namely glucose. The aglycones were prepared in sufficient quantity using chromatography on silica gel and identified as kæmpferol and quercetin respectively by spectral examination in the visible and ultra-violet regions, together with shifts in the absorption maxima on the addition of $AlCl_3$, NaOAc, NaOAc + H_3BO_3 and NaOEt, and through their R_f values in paper chromatography and T.L.C. in different solvent systems.

To summarise, *Adiantum venustum* contains 3-filicene, adiantone and a new triterpenoid keto-alcohol, a carotenoid which seems to be α-carotene monoepoxide, leucopelargonidin, kæmpferol glucoside and quercetin glucoside. Some new derivatives and reactions of iso-adiantone are described and a tentative structure (A) proposed for the new triterpenoid.

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Note.—In the latest issue of *Tetrahedron Letters* we have noticed an article by A. Zaman *et al.* (1966, p. 3943) describing the triterpenoids of *Adiantum venustum*. They too have isolated adiantone and 3-filicene, but by a different method from ours. They have also described a third triterpene for which they have deduced the structure 21-hydroxy-adiantone. With hot alkali or Ac_2O it was found to be transformed into a mixture of isomeric ketols for which they have suggested two tentative structures. It may be pointed out that the first of these two structures is being suggested by us for our third triterpene [*see* structure (A) earlier in this article].

3

GENETIC RECOMBINATION IN THE EVOLUTION OF PROTEIN MOLECULES

H. K. JAIN

Botany Division, Indian Agricultural Research Institute, New Delhi

ON the classical theory of gene, genetic recombination is expected, at best, to have a limited role in the evolution of protein molecules. This theory postulates that recombination is restricted to between genes ; on such a basis, crossing over would merely alter the sequence of coding units in the recombinant chromosomes. It would not result in the formation of new coding units. This, in turn, means that the protein molecules, information for whose synthesis is provided by individual genes, would not be affected at all in their structure. However, if there are exceptions to the one gene one polypeptide synthesis, some of the protein molecules may differ, as a result of recombination, from the parental molecules, in the sequence but not in the type and frequency of their different amino-acids.

The classical concept of the gene has been revised in recent years following the discovery of intragenic recombination, both in the eukaryotes showing chromosomal type organisation of their genetic material (*e.g.*, *Drosophila* and *Aspergillus*) and other organisms in which a DNA molecule corresponds to the chromosome. The attempts to interpret complex loci in *Drosophila* within the framework of the classical concept of the gene continue to present difficulties (*see* Lewis, 1951). The main difficulty arises from the failure of the so-called pseudoalleles to show complementation. For this reason, such alleles are best considered to involve mutation at different sites of the same gene, rather than in closely linked but independent units, arising through duplication. Even with recombination of the intragenic type, however, only changes of sequence are expected to be produced, unless the point of cross-over is located within a coding unit (codon) which is now widely accepted to be made up of 3 nucleotides (Crick, 1963 ; Lanni, 1964). If it is supposed that in a short segment of the DNA molecule (say 18 nucleotides), a potential point of cross-over cannot discriminate between different positions, it is just as likely to give intracodon recombination as intercodon. In fact, on a purely random basis, the chance for the former type is greater by a factor of more than 2. While there is considerable evidence in the case of higher organisms to show that the points of cross-over are not randomly distri-

buted (Darlington, 1935, 1937), the localisation appears to determine the range rather than the exact point of crossing over (Mather, 1938). There is no evidence at all to suggest that it operates at a molecular level. In micro-organisms also, non-random distribution of points of recombination is suggested in some cases by the phenomenon of negative interference (Pritchard, 1960), but here again no evidence is available for localisation at a molecular level.

The expectation on the occurrence of intra-codon recombination finds striking support from the work of Henning and Yanofsky (1962). These authors have described experimental evidence for recombination of this type in *Escherichia coli*. Their elegant studies have shown that the recombinant triplets code for an amino-acid is different from that coded by the parental codon. It is obvious that genetic recombination at this level becomes indistinguishable from the process of gene mutation ; and may have evolutionary implications, which the classical theory seemed to rule out.

These implications deserve attention, particularly in view of the evidence that the mechanism of recombination in higher and lower organisms may be basically alike. The partial chiasmatype hypothesis of Darlington (1937) postulates that an important step in the process of recombination is the breakage of the parental chromatids. This theory has found striking support from a number of studies (*e.g.*, Creighton and McClintock, 1931). It has also been shown by Meselson and Weigle (1962) and others that recombination in viruses involves breakage of the DNA molecules.

In view of these facts and the existence of interallelic recombination in both groups, it may be supposed that intracodon crossing over can occur in all sexually reproducing organisms. An important point for the present consideration is whether its magnitude can be such as to ensure for it a significant role in producing gene mutations.

Intracodon recombination, for a particular triplet, must necessarily be extremely rare, for nothing can be more closely linked than adjacent nucleotides. However, if recombination at the nuclear level is considered, a number of coding units can be expected to be affected in each of

the cells showing meiotic cell division, or a process corresponding to it. It has been seen that on a random basis, the chance for a cross-over point to be within a condon is twice as great as for it to lie between such units. The total number of such points in higher organisms can be readily determined by counting the number of chiasmata, which in favourable materials have been shown to have a one-to-one relationship with exchange of chromatids (see Brown and Zohary, 1955 ; Jain and Basak, 1963). In general, a median chromosome pair of average size, forms a minimum of 2 chiasmata, one in each arm. An organism having 12 such pairs, which is not a very large number, would in this way have 24 cross-over points in its chromosomes. In the absence of localisation at the molecular level, 16 of these can be expected to give intracodon recombination.

If all of these 16 cross-over points resulted in the formation of new coding units, recombination should constitute a significant source of new triplets. It is obvious, however, that not all of them would be effective. For them to be effective, the two parental codons involved must differ from each other in respect of at least two of their three nucleotides. The relative

PARENTAL HOMOLOGOUS TRIPLETS AND CROSS-OVER POINT	CROSS - OVER TRIPLETS	
	PARENTAL	RECOMBINANT

FIG. 1. Shows the expected formation of new types of triplets, when intracodon recombination involves coding units, which differ from each other in two of their three bases at various positions. The numbers correspond to different hypothetical nucleotides.

frequency of recombinant and parental triplets which would result from different pairs of codons of this type is shown in Fig. 1. The cross-over point has been shown to be randomly distributed over the two locations, and no double cross-overs have been considered in view of their improbability. The parental and recombinant types of nucleotide sequences which correspond to some of the hypothetical triplets shown here are presented in Fig. 2. In those cases, where the two parental triplets differ in all of their three nucleotides, the codons formed as a result of crossing over would be wholly of the recombinant type.

FIG. 2. The parental and recombinant coding units have been selected to correspond to the hypothetical triplets of Fig. 1. It should be made clear that the coding units shown here are of the messenger RNA; crossing over would involve them only indirectly, through the corresponding DNA segments, priming their synthesis. The amino acids for which they code have been shown in parenthesis. The nucleotide sequence in the units is arbitrary (after Nirenberg *et al.*, 1963).

Since the base composition of DNA in the genes cannot be analysed at present, it is not possible to determine the extent of such differences for the coding units in the different alleles of a gene. Theoretically, however, the difference need not be very great. It has been shown by Ingram (1963) that the hæmoglobin molecules, conditioned by the sickle cell mutant gene and its wild type allele, differ in respect of only one of their amino-acids. On the basis

of our present knowledge of the genetic code, it is possible to suggest that the two alleles may differ from each other in respect of no more than a single triplet out of the 300 or more which they may have. If this conclusion is correct, and if differences of this order are common for alleles at most loci, it would follow that the 16 intracodon points of recombination, randomly distributed along chromosome length, would have little or no chance of producing new coding units. A number of considerations, however, suggest that the inter-allelic differences in respect of the nucleotides may be of a greater magnitude.

The most important consideration in this respect is the degeneracy of the code. The code is recognised to be degenerate (*see* Crick, 1963 for a critical review) with many of the amino-acids having more than one triplet coding for them. This means that amino-acid differences, of the type found in the two hæmoglobin molecules, cannot be a reliable indication of the difference at the level of nucleotides in the corresponding DNA segments, which may be considerably greater. Mutational alterations of nucleotides in alleles of a gene can be expected to arise throughout the evolutionary history of the species, and such of these as have no immediate genetic consequences, because of degeneracy and other factors, would be preserved.

In this context, it is also relevant to consider the phenomenon of isoallelism. The iso-alleles may be expected to differ in several of their nucleotides, the difference being such that it does not affect the corresponding enzymes at critical sites, which would, therefore, show functional similarity. An example of alleles showing such similarity is provided by one of the mutants of the rII locus in phage T$_4$. The mutant 1589 is known to involve a deletion which extends over parts of two adjacent cistrons A and B (Benzer, 1962). It is observed that only the A gene behaves as a mutant ; the B gene retains much of its wild type activity. The occurrence of isoalleles shows that many homologous chromosome segments, which appear similar in their genetic effects, may be having nucleotide differences offering possibilities for intracodon recombination to be effective.

The above considerations suggest that the possibility of intracodon recombination giving rise to the formation of new non-parental type of coding units is not as negligible as it may appear at first sight. It may be concluded that at least a few of the 16 points of cross-over,

in the example considered above, may give rise to units of this type, particularly over a number of generations of sexual reproduction. This in turn means that a few of the several thousand enzymes and other protein molecules, which an individual carries, may be different from those of its parents, both because of spontaneously arising mutations and also because of the process of intracodon recombination. It would appear that of these two sources of variability, the one based on recombination has a more definite basis. While mutations for the most part arise irregularly through factors which remain obscure, intracodon recombination can be expected to arise regularly in all the thousands of cells giving rise to gametes in the course of sexual reproduction. Another important consideration is that neither gene mutations nor recombinant codons may give rise to amino-acid changes, if the DNA segment involved has a function other than that of coding for them. The existence of regulatory genes in *E. coli* (Jacob and Monod, 1961) and other organisms (Ames and Hartman, 1963) is of obvious interest in this context. However, the nature of the regulatory materials remains obscure, and indirect evidence, based on complementation studies, indicates that a repressor may also be a protein.

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LETTERS TO THE EDITOR

STUDIES IN EXPOSURE OF *ANADARA GRANOSA* TO THE SECONDARY COOLANT (SEA-WATER) OF A NUCLEAR REACTOR

THE secondary coolant—sea-water—from CIRUS nuclear reactor contains an appreciable amount of Cesium-137 at its outflow point. In order to study the fate of this radioisotope in the marine environment, especially with reference to the marine organisms in the vicinity of the discharge point, *Anadara granosa* (Linn.), a marine bivalve, commonly found in the region was exposed to the effluent and the resulting concentration of Cs-137 by the bivalve studied with time.

Figure 1 shows the design of the experimental set-up. As the secondary coolant has a temperature of $38 \pm 1°$ C. when the reactor is at full
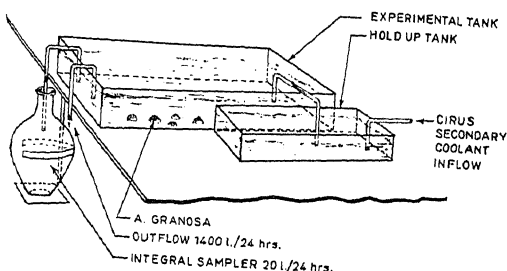
FIG. 1. Experimental set-up for exposing *A. granosa* to the CIRUS secondary coolant.

power (40 Mwe), a hold-up tank was found desirable. By maintaining the rate of flow at about 1400 litres per 24 hours through the experimental set-up, a temperature drop of $12 \pm 1°$ C. and a reduction of the silt load to tolerable limits was obtained in the experimental tank.[1] The above set-up was allowed to stabilize for about seven days before introducing the bivalve. A large population of *Anadara granosa* was transplanted from its natural habitat to the experimental set-up and withdrawn from the tank at intervals of 0, 1, 4, 8 and 10 days. The flesh was separated from the shell and ashed at 450° C. and then counted for gamma-activity using a 512 channel analyzer coupled with a well-type NaI crystal detector. The sea-water samples were collected daily on an integral basis—20 litres per 24 hours—and before being subjected to chemical analysis was further integrated to give 0–1, 0–4, 0–8 and 0–10 day samples. Cs-137 was separated by using phosphoammonium molybdate reagent and

the precipitate was counted in the same set-up as the flesh samples using identical geometry conditions. In addition salinity and pH variations were also recorded daily. The salinity varied from 34% to 36·5% (natural 35%), and the pH ranged from 7·6 to 8·3 (natural 8·1 to 8·2).

Concentration factors for Cs-137 in *A. granosa* resulting from exposure to a continuous flow of the secondary coolant from the CIRUS nuclear reactor is given in Table I.

TABLE I

Days	Cs-137 in water cpm./ml.	Cs-137 in flesh cpm./gm. wet	Concentration factor
0	1·9*	0·14†	..
0–1	1·3	21·30	18·7
0–4	1·2	38·60	30·9
0–8	1·8	63·20	34·3
0–10	0·4	37·50	85·0

* CIRUS secondary coolant-Cs-137 activity at the start of the experiment.
† Cs-137 concentration in the animal before starting the exposure.

Table I and Fig. 2 summarize the concentration factors resulting in *A. granosa*. It is
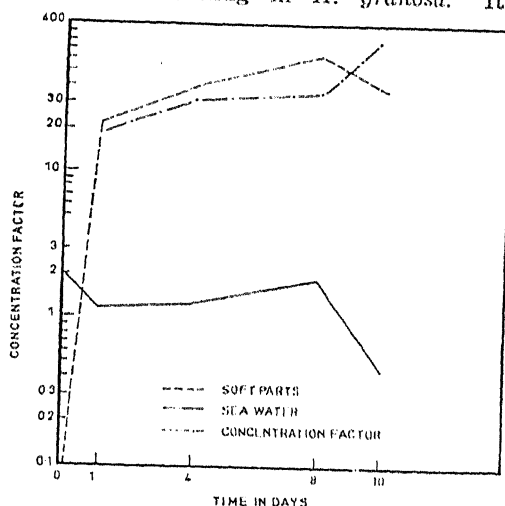
FIG. 2. Cesium-137 in soft parts of *A. granosa* and CIRUS secondary coolant with resulting concentration factors.

evident that there is a rapid rate of uptake in the first 24 hours coupled with a high activity of Cs-137 in water. During the period 1–8 days, the rate of uptake is doubled but the doubling time is considerably less as compared

to the initial increase over 24 hours. This could be attributed to the decline of activity of the sea-water. The sudden increase in activity of the sea-water during the 4–8-day interval, is however felt only towards the 8–10-day interval, even though there is a drop in activity in sea-water for the corresponding period. The rather high concentration factor of 85 could be attributed to a slower turnover in the organism. In laboratory experiments[1] using *Katelysia marmorata* it was found that the concentration factor for Cs-137 was 10 under equilibrium conditions which was reached within 65–70 hours, but under a continuous flow system with activity being injected into the system at varying intervals and in varying concentrations achieving equilibrium may take quite a long time, hence the rather high concentration factor in *A granosa* as compared with *K. marmorata*. The former could be considered as a chronic exposure case and the latter as an acute exposure case.

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Health Physics Division,   J. R. NAIDU.
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Trombay,
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THE RADIATIVE COOLING OF THE ATMOSPHERE AT COASTAL AND CONTINENTAL STATIONS

IT was shown by Möller and Mügger (1931) that the atmosphere, at least limited to the troposphere, continually loses heat through long-wave radiation. Since the absorption of insolation by the atmosphere is comparatively small, net radiative processes also result in an atmospheric heat loss. This was first clearly indicated by Möller (1935). Subsequent investigations (Elsasser, 1940; Tanck, 1940), while limited in scope, have substantiated this fact.

In the present note, the average infra-red flux for water vapour and flux divergence in the atmosphere during 1964 is computed graphically from Elsasser radiation charts (Elsasser,

1940 A) for the coastal station, Waltair (17° 43′ N., 83° 14′ E.) and for the continental station, Nagpur (21° 06′ N., 79° 03′ E.) using the radiosonde observations of clear skies. The net radiative flux divergence is then computed by methods of finite difference. The mean monthly net fluxes obtained at surface and 850 mb. levels for the two stations are given Table I.

TABLE I
Mean monthly net fluxes of long-wave radiation from December 1963 to November 1964

Months		F_{NB}	F_{NT}	F_N $F_{NB}\sim F_{NT}$	Mean of δF_N $\dfrac{\delta F_N}{\delta P}$ for season	Mean of $\triangle T$ $\dfrac{\triangle t}{}$ for season °C./day
				Waltair		
Dec.	1963	18·68	28·13	9·45		
Jan.	1964	18·30	27·45	9·15	0·063	2·07
Feb.	1964	18·52	28·27	9·75		
March	1964	18·42	29·33	10·91		
April	1964	18·22	28·98	10·76	0·072	2·36
May	1964	16·88	27·61	10·73		
June	1964	16·75	25·50	8·75		
July	1964	16·62	25·27	8·65	0·057	1·87
Aug.	1964	16·52	25·02	8·50		
Sept.	1964	17·22	25·52	8·30		
Oct.	1964	17·78	26·44	8·66		
Nov.	1964	18·33	26·39	8·06	0·056	1·82
				Nagpur		
Dec.	1963	20·38	27·54	7·16		
Jan.	1964	20·40	27·48	7·08	0·059	1·94
Feb.	1964	22·88	29·88	7·00		
March	1964	23·35	31·17	7·82		
April	1964	23·04	30·92	7·88	0·066	2·16
May	1964	23·66	31·72	8·06		
June	1964	17·42	24·02	6·60		
July	1964	16·92	23·62	6·70	0·055	1·80
Aug.	1964	16·54	23·06	6·52		
Sept.	1964	16·83	23·44	6·61		
Oct.	1964	19·48	25·62	6·14		
Nov.	1964	19·43	25·77	6·34	0·052	1·71

Note: All fluxes are expressed in langleys per 3 hours.

The rate of radiational cooling of the atmosphere from the vertical divergence of the net flux is given by the equation,

$$\frac{\triangle T}{\triangle t} = \frac{g}{c_p}\frac{\delta F_N}{\delta P}$$

where δF_N is the net flux difference and δP is the pressure difference between the boundaries of the layer. These results indicate that if the net upward flux at the surface (F_{NB}) is less than the net upward flux at the 850 mb. level (F_{NT}') (net flux divergence) cooling will result, while if $F_{NB} > F_{NT}$ (net flux convergence) warming will occur. The

value of $\triangle T/\triangle t$ is expressed in ° C. per day when δF_N is in gram cal. per cm.^{2} per day, δP is in millibars, t is in days and the numerical value of the constant g/c_p is 4·1.

The mean radiational cooling for winter, summer, south-west monsoon and post-nonsoon periods are obtained during the year 1964 for the two stations as shown in Table I. From Table I, it is observed that at the two stations the largest radiational cooling of the atmosphere (troposphere) occurred in the summer. It is also observed that the radiational cooling in all seasons at the continental station, Nagpur, is smaller than that of the coastal station, Waltair. This is due to the occurrence of the higher specific humidities at the coastal station than the continental station. These higher specific humidities at the coastal station are mainly due to the influence of the sea. The present calculated cooling values at the stations are in good agreement with those values obtained by London (1957) for the infra-red radiative cooling of the atmosphere.

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Dept. of Meteorology and   R. RAMANADHAM.
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FORMATION OF INDANE-1, 3-DIONES FROM PHENYL ACETATES AND MALONYL CHLORIDE

IN the condensation of hydrocarbons with substituted malonyl chlorides under the Friedel-Crafts reaction conditions, Freund and Fleisher[1] reported the formation of indane-1, 3-diones along with dibenzoylmethanes and β-lactones as bye-products. Applying this procedure to the interaction of various malonyl chlorides

with resorcinol dimethyl ether, methyl-p-tolyl ether and other alkylated phenols, Walkers, Shaw and others[2][4] prepared over thirty compounds which were regarded as indane-1, 3-diones. Reinvestigation of this work in connection with an attempted synthesis of 4, 7-dimethoxy indone-1, 3-dione by Garden, Hayes and Thompson[5] showed that the compounds were not indane-1, 3-diones but 4-hydroxy coumarins.

During the present investigation, it was considered worthwhile to condense substituted phenyl acetates with malonyl chloride to see whether indane-1, 3-diones are formed. p-Tolyl acetate, p-acetamino phenyl acetate, hydroquinone diacetate, p-chlorophenyl acetate, p-bromophenyl acetate, o-chlorophenyl acetate and 2 : 4-dichlorophenyl acetate have been condensed with malonyl chloride in the presence of aluminium chloride at 100°. In the case of p-tolyl acetate and hydroquinone diacetate, the corresponding o-hydroxy acetophenones have been obtained whereas with p-chloro, p-bromo, o-chloro and 2 : 4-dichloro phenyl acetates products other than o-hydroxy acetophenones have been isolated. These substances appear to have similar structures as indicated by their U.V. ($\lambda_{max.}^{ethanol}$ 275 and 305 mμ) and I.R. ($> C=O$ 1605 cm.$^{-1}$ and 1725 cm.$^{-1}$).

The compound formed in the condensation of p-bromophenyl acetate and malonyl chloride has been investigated in detail as a representative case. The product obtained can have one of the three possible structures (I-III)
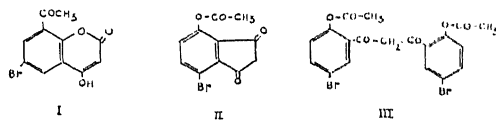
As the mass spectrum of the compound indicated its molecular weight to be 282, structures I and II alone are possible. The fragmentation pattern of the compound confirms the indane 1, 3-dione structure.

TABLE I

Fragmentation pattern of the condensation product

m./e.	Relative abundance %
282	100
267	34
240	90
198	10
170	63
63	59
43	100
28	56

TABLE II

Sl. No.	Ester Condensed Phenyl Acetate		Product Indane-1, 3·dione	M.P. (°)	Hydrolytic Product Phthalic acid	M.P. (o)
1	p·Bromo	..	4·O·acetyl 7·bromo	198	3-hydroxy-6-bromo	167
2	o·Chloro	..	4·O·acetyl·5·chloro	194	3·hydroxy-4·chloro	178
3	p·Chloro	..	4·O·acetyl-7·chloro	180	3-hydroxy·6·chloro	187
4	2 : 4 Dichloro	..	4·O·acetyl 5, 7·dichloro	198	3-hydroxy-4, 6·dicholro	206

On hydrolysis with 15% alkali, an acid was obtained which gave a violet ferric colour indicating chelation, confirmed by I.R. absorption. It gave a positive phthalein test. On decarboxylation of the acid with quinoline-copper, p-bromo-phenol was obtained. The acid, based on these facts, may be 3-hydroxy-6-bromo-phthalic acid and the condensation product 3-acetoxy-6-bromo–indane-1, 3–dione.

On analogy, and on the basis of the U.V. and I.R. spectral data the compounds obtained in all other cases have been assigned the indane-1, 3-dione structure. The formation of indane diones appears to take place with such phenolic esters which do not undergo Fries migration under the reaction conditions. The melting points of the condensation products, hydrolytic products are given in Table II.

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Dept. of Chemistry,   S. R. MOORTY.
Osmania University,   V. SUNDARA MURTHY.
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PAPER CHROMATOGRAPHY OF BLOOD PLASMA FOR BIRD TAXONOMY

THE conventional tools used in animal taxonomy are the discriminatory features. But when pertinent differences are absent in related members, the separation of species becomes a problem. To avoid this difficulty, some workers introduced a biochemical approach to the problem with the application of paper chromatography and protein electrophoresis to provide a more discriminating tool for taxonomy. Kirk and Main[1] have demonstrated that separation of different species of land snails is possible by paper chromatography. According to Micks[2] this method provided an accurate basis for distinguishing between members of the *Culex pipiens* complex. Viswanath and Pillai[3] applied this technique to distinguish the different species of fish. Sibley[4] gives electrophoretic profiles for the avian egg-white protein in some species of birds. The work of Mainardi[5] has shown that erythrocyte antigen characters can be utilised to classify birds. Gysels'[6] work with eye-lens protein has enriched the field of bird taxonomy.

The method of paper chromatography[1-3] with slight modification (two dimensional, ascending type) has been used in this present work for the identification of two related species of Myna. Instead of muscle, eye-lens, egg-white or any other body component, the present authors have used blood plasma for this purpose. It has been found that the plasma can be used satisfactorily in place of any one of the materials mentioned above. The birds taken were two types of Myna, (*a*) Bank myna (*Acridotheres ginginianus*, Latham) and (*b*) Pied myna (*Sturnuspastor contra*, Linn.) widely distributed in Northern India and East Pakistan.

The blood was collected directly from the heart in a tube with small quantity of heparin to prevent coagulation, and was centrifuged to separate the plasma from the cells. The protein was precipitated by means of trichloro-acetic acid solution (10% W./V.) from the separated plasma and was hydrolysed by 6 N HCl at 100° C. for 24 hours. The mixture of liberated amino-acids was taken out and applied in a usual procedure[7] on Whatman No. 1 filter-paper for two-dimensional chromatography (ascending type). The solvents were water saturated phenol (first run) and butanol, acetic acid, and water in the ratio of 4 : 1 : 1 (second run). The spots were developed by spraying 0·5% ninhydrin solution in acetone.

The developed chromatograms for each member of Myna group revealed consistent differences in their ninhydrin positive spot patterns and the differences are quite significant. The chromatogram A is of Bank myna and chromatogram B belongs to Pied myna. Comparison of these two chromatograms shows
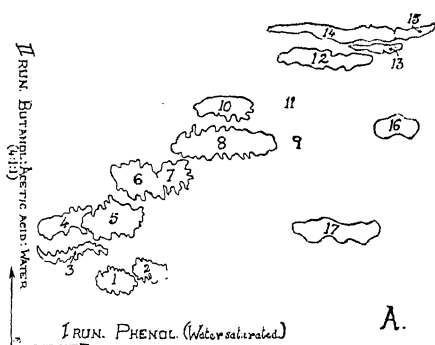
FIG. 1
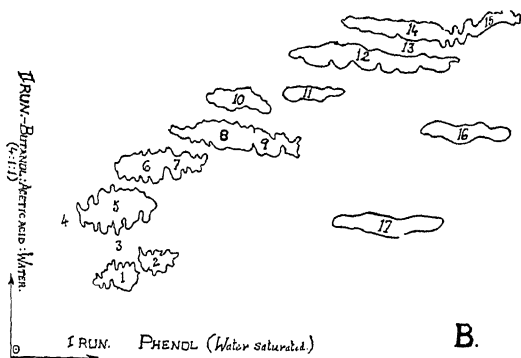
FIG. 2

that though the total number of ninhydrin positive spots are more or less same, yet they are not similar in nature. In both A and B chromatograms spots No. 1 and 2 are present, but spot 3 is absent in chromatogram B. Similarly spot 5 is present in both the chromatograms, while 4 is absent in B. Spots No. 6, 7, 8 and 10 are present in both A and B chromatograms, whereas 9 and 11 are present only in B. Spot 13—a comparatively smaller spot—is present in A and absent in B. The rest of the spots 12, 14, 15, 16 and 17 are present in both the cases. Thus it shows how significantly the chromatograms differ from one another. The other differences are given below.

1. *Chromatogram A.*—(1) The distance of the lowest spot from the starting point—2·5 cm.; (2) The distance of the topmost spot from the starting point—14·5 cm.; (3) The total number of ninhydrin positive spots—15.

2. *Chromatogram B.*—(1) The distance of the lowest spot from the starting point—3·5 cm; (2) The distance of the topmost spot from the starting point—15·5 cm.; (3) The total No. of ninhydrin positive spots—14.

G. C. Bose Res.   KINSUK SEN.
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Bangabasi College, AMALESH CHOWDHURY.
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A METHOD TO MAKE THE DIGEST OF THE EPIDERMIS OF THE MAMMALS IN NORMAL SALINE SOLUTION

SHUKLA, KARKUN AND MUKERJI[1] described a method to digest the epidermis of the black guinea-pig and the epidermis of the normally pigmented human beings in 1 mg./ml. solution of 3, 4-dihydroxyphenylalanine in normal saline (DOPA-saline). In these preparations, the internal structure of the melanocyte is completely masked by the intense dark tone produced by the DOPA reaction.[2,3] A method to make the digest of the epidermis of mammals in normal saline solution where (I) the internal structures remain unmasked by premelanin stained by DOPA and (II) where the nuclei can be demonstrated without prior demelanisation, is described.

The pure epidermis preparation of Medawar[4] (Fig. 1), after being fixed in formal calcium as described by Shukla *et al.* (*loc. cit.*), is treated with normal saline solution adjusted at a pH of 7·7 with M/15 phosphate buffer at 37° C. for an hour. After this period the epidermis is taken out, spread on its epidermal side in a watch glass filled with normal saline solution and dabbed with camel hairbrush till all the cells constituting the layers of the epidermis, except of stratum corneum and lucidum (Fig. 2), are separated into complete individual identities. The cell digest so obtained is mounted on albuminised slides, dried in an oven at 58° C. for an hour, washed in running water for 4 hours, dehydrated in ascending series of alcohol, cleared in xylol, mounted in balsam and examined under the bright field microscope. The isolated cells of the basal, Malpighian, granular and the melanocytic layer along with Langerhans' cells of the peroneal surface of the leg of the normally pigmented human epidermis, are respectively shown in

Figs. 3, 5, 7, 9, 11. Another portion of the epidermal digest, after being mounted on the albuminised slide, is stained with Mayer's hæmalum, dehydrated in ascending series of alcohol and mounted in balsam as before (Figs. 4, 6, 8, 10, 12).

guinea-pig,[7] and is identified by the less dichotomously branched, thinner and fine-tipped dendritic processes[8] and deeply basophilic, shrunken and fusiform nucleus with scanty, melanin-free cytoplasm (Fig. 12).

Thanks are due to Shri R. K. Saraut and
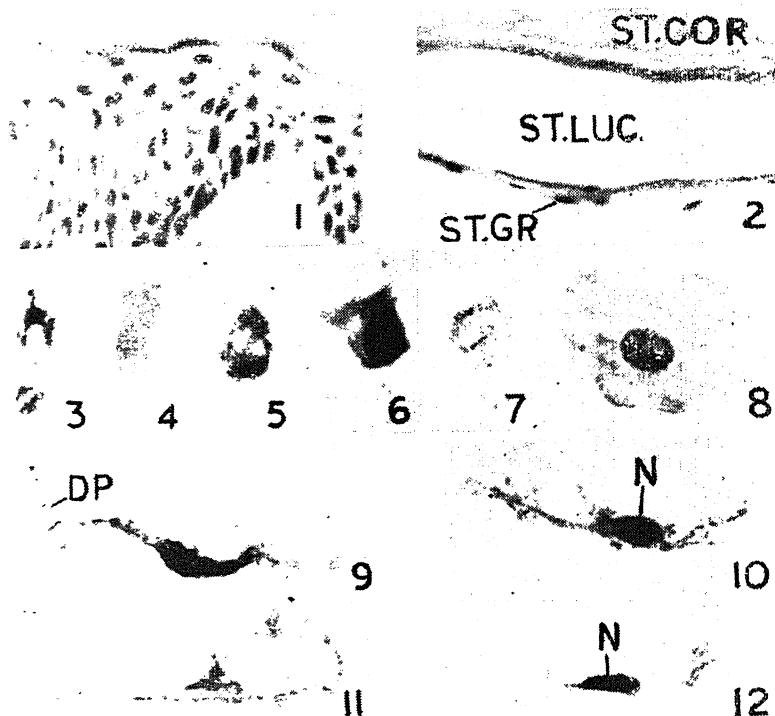
FIGS. 1-12. Fig. 1. Transverse section of the pure epidermis preparation of the human skin from the peroneal surface of the leg. H.E. Stain, × 650.   Fig. 2. Transverse section of the remnant portion of the pure epidermis preparation after degestion in normal saline. Stratum corneum (ST. COR.), stratum lucidum (ST.LUC.) and few of the cells of the uppermost layer of stratum grannulosum (ST.GR.) were left undigested. H.E. Stain, × 650. Figs. 3, 5 and 7 respectively show the unstained and isolated basal, Malpighian and granular cell. Fig. 9 shows the dark, melanin laden straight type of the melanocyte with stout dichotomously branched dendritic processes (DP.), × 950. Fig. 11 shows a thin dendritic process bearing straight type of Langerhans' cell without any melanin in its cytoplasm. Figs. 4, 6, 8, 10 and 12 respectivly show the basal cell, Malpighian cell, granular cell, melanocyte and the Langerhans' cell after Mayer's hæmalum stain. The deeply basophilic, shrunken, fusiform nucleus of the Lengerhans' cell is seen to occupy the whole of the cytoplasm. The vesicular, egg-shaped, moderately basophilic central nucleus of the melanocyte shows an ample rim of cytoplasm around it, × 950.

The isolated cells, being visible in their entirety, are easily identified by their shape and the character of the nuclei. The melanocyte, as described by Shukla and Mukerji,[5] and Shukla,[9] can be identified by the stout, dichotomously branched and bulb-tipped dendritic processes. Cytologically, it is recognised by the egg-shaped, double-notched basophilic nucleus (loc. cit.) surrounded by an ample amount of cytoplasm loaded with exuberant mass of melanin. The human Langerhans' cell, which is difficult to differentiate from the melanocyte in sections of skin,[6] is found to bear a fusiform body like that of the Type IV Langerhans' cell of the black

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Central Drug Res. Inst.,   R. C. SHUKLA.
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TRITERPENES FROM *DAPHNE CANNABINA* WALL.

THIS is in continuation of our earlier report[1] on the triterpenes of *D. cannabina* wherein the petroleum ether extract of the leaves was found to contain mainly taraxerol (0·1%) and taraxerol acetate (0·07%). A minor fraction (0·012%) has since been isolated. This crystallizes from benzene-petroleum ether in needles, m.p. 239–40°, $[a]_D^{31} + 11·5°$ ($CHCl_3$), analyses for $C_{30}H_{48}O$, responds to Liebermann Burchard test and colours tetranitromethane yellow. The infra-red spectrum suggests six-membered ring ketone (1710 cm.$^{-1}$) and gem-dimethyl group (1360 cm.$^{-1}$, 1378 cm.$^{-1}$). The Zimmermann test[2] is also positive. All these findings indicate that the compound is taraxerone. The mixed m.p. of this compound and an authentic sample of taraxerone remained undepressed, their I.R. spectra were superimposable and T.L.C. identical. The compound is thus found to be taraxerone.

Taraxerone has been reported from a number of plants rarely alone[3] and often associated with taraxerol.[4-8] This appears to be the first record of taraxerol, taraxerone and taraxerol acetate occurring simultaneously in nature.

The authentic sample of taraxerone was obtained by chromic acid oxidation of taraxerol isolated from this plant.[1]

Central Forensic Science Lab.,   P. C. MAITI.
30, Gorachand Road,   SUJATA ROY.
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TECTONICS OF THE SONE VALLEY VINDHYANS

AFTER elucidating the stratigraphy and regional geology of the Vindhyans of Sone valley, Auden[1] concludes that the compressive stresses causing the various structures of the area were directed from North to South. Both Krishnan[2] and Pascoe[3] contend that the compression seems to have been directed from South or South-west.

Studies of the Joint- and Fault-patterns in relation to the Fold-axes indicate that the Vindhyan rocks on the main appear to have been affected by tectonic stresses directed towards N-NNW. The following are the pertinent evidences in support of this contention.

In the area south of Chopan, the majority of faults seen in the Porcellanite stage are of the reverse type, trending NE (ENE)-SW (WSW), with their northern compartments down-thrown. Close to the confluence of Rihand river with Sone river (near Sinduria village) is present a system of reverse faults, hading SE, which have brought up the Porcellanite rocks in an otherwise westerly descending sequence (incidentally this patch of Porcellanites has been wrongly mapped as part of lower Basal stage.)[1] Structural studies of the faulted anticlines and the Joint-patterns of the Porcellanite rocks along the south bank of Sone river (north of Chopan) reveal a preponderance of fold-axis oriented approximately ENE-WSW with the northern limbs of individual folds cut off completely by longitudinal faults or attenuated to verticality. The systems of Shear joints in the hard bands (cherty layers) (NNE-SSW in northern limbs; NW-SE in southern limbs) and of the fracture cleavages in the soft bands (siltstone-tuff layers) (N-S in northern limbs; NNW-SSE in southern limbs) conform generally to the stress direction of NNW-SSE. The system of bedding joints (tensional) further corroborates this deduction.

North of Sone river, in the Markundi amphitheatre, is noted a number of reverse faults, both in cliff and profile sections, hading SE-SSE (*e.g.*, Rudauli fault, Silthari fault, etc.[1]). Further north outcrops the major Markundi-Jamual fault which, curiously enough, was interpreted as a normal fault hading north.[1] This appears to be an undoubted major up-thrust structure with the Bijawars coming in contact successively with younger units of Lower Semris by cutting out the older ones. At the quarry-site of Markundi village, the Rohtas limestone is practically in juxtaposition with the Kaimur Scarp sandstone with all intervening Lower Kaimur stage members completely cut off. The southern boundary fault of Vindhyans, south of Kajrahat and Sone river, has probably a similar tectonic significance and naturally would not represent the original limit of Vindhyan sedimentation as is generally assumed. This tectonic feature is further made remarkable by the near-vertical attitude of Kajrahat limestone and other Basal stage members. Further north, between Agori and

Churk, is exposed a magnificent thrust fault along which a southerly syncline of Upper Quartzites (Lower Kaimurs) overrides a northerly anticline with the consequent development of disharmonic folds in the overlying Bijaygarh shales. This thrust structure is probably intimately related to the similar trending Markundi fault and caused by a northward oriented compressive stress.

All these evidences bear out that the Vindhyan rocks of Sone valley have been *a priori* subjected to N-NNW bound tectonic stresses.

Post-Graduate   N. DASARATHI.
    Department of Geology,
Univ. of Jammu and Kashmir,
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SEED FAT OF *MOMORDICA TUBEROSA* OR *LUFFA TUBEROSA*

Momordica tuberosa or *Luffa tuberosa* is a plant of considerable economic importance as its green fruits are used as a vegetable. In view of this and the unique nature of the fatty oil which the seed contains, as shown later, the plant deserves better agricultural and horticultural attention. No data are available on the seed fat of the plant. Investigations on the seed from ripe fruits seasonally (January) available in Anantapur District were therefore undertaken.

From 11·25 kg. of fruits, 2·48 kg. of sun-dry seeds were obtained. Oil forms 25·3% of the whole seed and 40% of the kernels.

Kernels were extracted in cold by petroleum-ether which was cautiously removed under vacuum at low temperature. The oil thus extracted had the following characteristics: Colour, yellow-green; η_D^{25} 1·4993; F.F.A. 1·5; Iod. No. (Modified Wijs' method for conjugated system) 183 and Sap. V. 190.

The oil became a solid resembling crepe or spongy foam rubber after some days in presence of air. The solid was insoluble in common solvents like *n*-hexane, acetone, benzene, chloroform, carbon tetrachloride, etc., showing that it is a polymerized material of the oil.

The oil answers tests characteristic of a quick-drying polymerizable oil like tung oil containing high proportions of conjugated

trienoic acid like *alpha*-eleostearic acid. The tests are, red colour with methanolic solution of bromine and calcium bromide with nitric acid, ferric ammonium alum and ammonium thiocyanate,[1] a dark brown ring with chloroform solution of antimony trichloride[1] and gel formation followed by glassy wrinkles when exposed to sunlight or subjected to heat in presence of air.

TAXONOMY OF THE PLANT

The plant belongs to the botanical family *Cucurbitaceæ*. Regarding genus, there are two classifications based on botanical characteristics, one placing it under *Momordica*[2] (*Momordica cymbalaria,* Fenzl ex Naud syn. *Momordica tuberosa* Roxb. Cogn) and the second under the genus *Luffa*[3] (*Luffa tuberosa*). In the present work, it is shown that the seed fat of the plant contains a conjugated triene acid as that of *alpha*-eleostearic acid which is a characteristic of seed fats of *Momordica* genus: *M. charantia* contains 46·7%,[4] 43·7%[5] and *M. dioica,* 54·9%[4] of *alpha*-eleostearic acid. *Luffa* genus is not reported to contain conjugated triene acid.[4]

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NOTE ON SOME MICROFOSSILS FROM THE FORT AREA, BOMBAY

THE first author of this paper, during a visit to Bombay in 1965, examined some well sections in the Fort area, where sweet water was available within 7 m. of ground level in open wells piercing a bed of soft semi-consolidated materials of greyish colour. Megascopic examination of these materials, which are calcareous, revealed the presence of organic particles, mainly foraminiferal tests and broken shells, comprising chiefly lamellibranchs, and some minute mineral fragments associated with clayey and oolitic

granules. The fossiliferous bed, having a thickness of about 7 m., has been deposited over the Deccan Traps and appears to have been subsequently raised to the present level. The area from which the fossiliferous material was collected essentially forms a flat ground on the western side of the Bombay island stretching north-south through the Oval ground, Mahalakshmi Race Course and further beyond having an areal extent of about 10 km.[2]

The following microfossil assemblage[1-8] has been identified in the materials collected from a small open well inside the Gymkhana Club (Well No. 3 in Fig. 1).

GEOLOGICAL MAP OF BOMBAY AREA SHOWING FOSSIL LOCALITY

SCALE 1 : 31,680

I N D E X
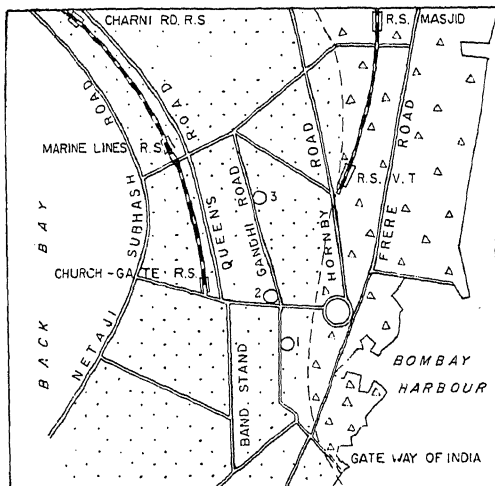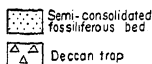
Semi-consolidated fossiliferous bed   1 2 3 Open wells examined in the Fort area

Deccan trap   3 Gymkhana well from which sample of fossiliferous material was collected

FIG. 1

1. *Foraminifera*:
    (1) Family—Miliolidæ d'Orbigny, 1839.
        Quinqueloculina seminula (Linn.)
        Quinqueloculina sp. indet.
        Triloculina trigonula (Lamarck)
        Massilina secans (d'Orb.).
        Prœmassilina rugosa (Sidebottom).
        Spiroloculina antillarum d'Orb.
        Miliola saxorum Lamarck.
    (2) Family—Rotaliidæ Reuss, 1860.
        Streblus beccarii (Linne).
        Anomalina balthica Schr.
        Anomalina sp.
        Cibicides sp.

    (3) Family—Nonionidæ Reuss, 1860.
        Nonion cf. *scapha* (Fich.).
        Elphidium minutum Reuss.
        Elphidium aff. *craticulatum* (Fichtel and Moll).
        Elphidium sp. indet.

2. *Ostracoda*:
        Bairdia sp.
        Henryhowella sp.

A study of the fossil assemblage suggests that the material examined may be Miliolite Limestone,[3,5] so common along the west coast or may be 'Littoral Concrete'[5] referred to by Pascoe (1963 ; p. 1906). The microfossils and the degree of their fossilisation is suggestive of a Pleistocene to Sub-Recent age for the contained bed. The authors are not aware of any previously published record of the microfauna from the Fort area, Bombay.

Besides the important fossil assemblage referred to, the fossiliferous bed described above is of economic significance in that it forms a good aquifer from which fresh groundwater can be tapped.

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Hyderabad-1 (A.P.),   K. K. VERMA.
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ENSTATITE, ENDIOPSIDE AND DIOPSIDE FROM THE KONDAPALLI AREA

DURING the course of a mineralogical study of the ultrabasic rocks from the charnockitic region of Kondapalli (lat. 16° 37′ and long. 80° 32½′), Krishna District, Andhra Pradesh, the author has investigated in detail the pyroxenes from orthopyroxenite (48), clinopyroxenite (472) and websterite (323). The orthopyroxene 48 ($+ 2V = 80°$; $\gamma = 1.676 \pm 0.002$) forms 98% by volume of the rock and the clinopyroxene (472) forms 91% of the respective rock ; both the pyroxenes contain very rare (100) exsolution lamellæ. The orthopyroxene (323) shows occasional (100) exsolution lamellæ of clino-

pyroxene and the coexisting clinopyroxene (diallage) exhibits (100) lamellæ of orthopyroxene; the orientation and composition of these exsolution lamellæ were determined by single crystal X-ray work[1] and by use of the electron probe X-ray microanalyzer.

The pyroxenes were separated from their host rocks by repeatedly using an isodynamic separator and centrifuging in Clerici's solution, until all the samples were not less than 99·5% pure as judged under the petrological microscope. The data obtained from the chemical analyses of the four pyroxenes are summarized in Table I. The problem of the partition of

TABLE I

	OPX (48)	OPX (323)	CPX (323)	CPX (472)
Fe^{+2}/Mg ..	0·08	0·22	0·12	0·20
$100 \; Mg/Mg + Fe^{+3} + Fe^{+2} + Mn$	91·57	81·28	84·59	81·31
Atomic % Ca ..	0·36	0·98	43·15	48·49
Mg ..	91·24	80·48	48·09	41·88
$Fe^{+3} + Fe^{+2} + Mn$ ..	8·40	18·54	8·76	9·63

OPX = Orthopyroxene,   CPX = Clinopyroxene

48 Orthopyroxenite from south of the hill 3¾ miles NNW of Kondapalli R.S. 323-Websterite from top of Nakkal Banda, 1½ miles SW of Kondapalli R.S. 472-Clinopyroxenite from the hillock, ¼ mile north of Kotta Ibrahimpatnam Village.

Fe^{+2} and Mg in coexisting pyroxenes is of interest[2] and the partition coefficient Kp [= $(Fe^{+2}/Mg) OPX \div (Fe^{+2}/Mg) CPX$] is equal to 1·9 for the pyroxene pair 323 and this Kp value is characteristic of the granulite facies rocks. When the data in Table I are represented on a Ca-Mg-ΣFe trilinear compositional plot (Fig. 1, slightly modifiel, after Poldervaart and

ATOMIC PER CENT

FIG. 1

Hess[3]) it is observed that the analyzed pyroxenes fall in the fields of enstatite (48), bronzite (323), endiopside (323) and diopside (472). These pyroxenes are more magnesian than those reported for the Madras charnockitic region.[4,5] As far as the author is aware, the orthopyroxene 48 (En_{92}) is more magnesian than any analyzed orthopyroxenes reported from other charnockitic terrains of the world. Recently an orthopyroxene (En_{97}, determined from optical data) from Kondapalli more magnesian than the orthopyroxene (48) is reported by Fuchs.[6]

This work was carried out in the Department of Mineralogy and Petrology, Cambridge (England), under the supervision of Prof. W. A. Deer, F.R.S.

Geology Department,   C. LEELANANDAM.
Osmania University,
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WARKALA BEDS AT KOLATTUR

THE Warkala beds of Tertiary age, best developed along the coastal belt, are also seen in some places inland as detached patches which have not been studied previously. One such occurrence, underlain by the crystalline rocks, was reported early by Chacko[1] at Kolattur (58 H/₁₄), 1·6 kilometres north of Veli R.S., near Trivandrum, but further details are not available. Some features on the lithology and succession, recently observed, are mentioned in this note.

Though the beds do not outcrop, a number of well sections reveal four lithologic units which are, in descending order, variegated clay, carbonaceous clay, sandstone and carbonaceous sandy clay. Animal fossils are absent but leaf impressions are common in the carbonaceous clay.

Variegated Clay.—Slightly gritty, about 6 metres thick, grey, plastic, indistinctly laminated. Yellow and reddish-brown patches and streaks of ferruginous matter occur near the top but disappear downward. Small fragments of brown woody matter and resin are scattered all over.
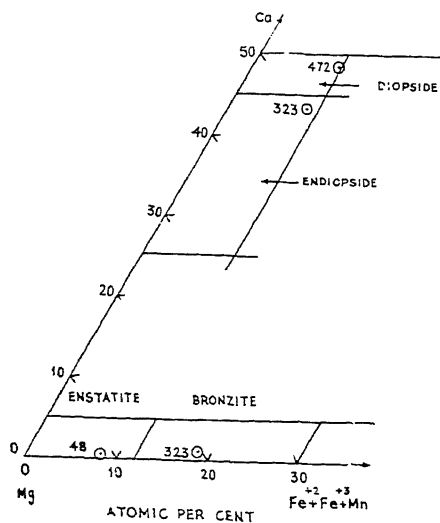
Carbonaceous Clay.—The bed is about 8 metres thick, brownish-grey, crudely laminated, plastic and somewhat gritty caused by quartz grains mostly angular but including a few sub-rounded frosted grains. Small fragments of lignite and resin and pseudomorphs of marcasite are also present. Specks of sulphur-like powder identified to be natrojarosite[2] were also observed in hand specimens.

Sandstone.—The bed is 1 metre thick, grey, medium-grained and composed of quartz with small amounts of partly weathered felspar and opaque minerals in a clay matrix. Pieces of brown woody matter and resin also embedded.

Carbonaceous Sandy Clay.—The contact with the overlying sandstone is marked by springs of sour taste and a strong sulphurous smell. The exposed part of the bed is about 2 metres thick. It is brownish-black, arenaceous and contains small logs of lignite with resin and marcasite. Minute yellow patches of natro-jarosite are present. The lignite is black with a fibrous columnar structure which is retained by the marcasite. The quartz grains are unsorted, angular to subrounded; some of the latter being frosted.

The difference in colour between the woody matter in the carbonaceous clays and the other beds is striking. This may be due to incomplete transformation resulting from unusual environmental factors.

Conclusion.—The strata do not represent the complete series as exposed at Warkala,[3] the type area. Close resemblance between the lignite-bearing carbonaceous sandy clay and the lower lignite seam at Warkala strongly suggests equivalence. Such a relation was suggested for the carbonaceous clay at Chathanur[4] with the Warkala lignite bed. Correlation of strata in different sections remains unsatisfactory owing to lateral variations, irregularity in the order of succession and absence of certain beds in some sections.

Department of Geology,   K. K. Menon.
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ON THE SUCCINIC DEHYDROGENASE ACTIVITY OF THE FAIRY SHRIMP *BRANCHINELLA KUGENUMAENSIS* (ISHIKAWA)

Even though there have been a few reports on the systematics and morphology of the fairy shrimp *Branchinella kugenumœnsis* (Ishikawa)[1] which occurs invariably in astatic pools of Madurai, very little is known of their physiology including their respiratory activity. As a measure of their respiratory potential the succinic dehydrogenase activity of this animal was determined after Kun and Abood.[2]

Branchinella used for the experiments were collected from temporary ponds in Madurai. As the eyes and tail of these animals and the brood pouches of the females contain pigments which are soluble in acetone, they were carefully removed and the remaining parts of the body weighed. The tissue was ground with a glass rod and incubated in a constant temperature water-bath for one hour at the respective temperatures. The optical density of the acetone extract was measured in a Lumetron colorimeter at $420 \, m\mu$ and the quantity of formazan calculated from a standard graph. As the bodies of these animals have a pinkish tinge a control experiment of a male and female without the addition of triphenyl tetrazolium chloride was run for each set of experiments and a correction factor applied for the reading.

The succinic dehydrogenase activity was estimated at four temperatures, namely 15°, 25°, 30° and 40° C. Further, this activity was also measured using the tissues of the head, thorax and abdomen at the laboratory temperature (34° C).

A perusal of Table I will show that with increase in temperature from 15° to 30° C the succinic dehydrogenase activity also

TABLE I
Effect of temperature of the succinic dehydrogenase activity of Branchinella

Temperature (°C)	Sex	Wet weight (mg.)*	μg. of dye reduced/ mg./hr.*	Average μg. of dye reduced/ mg./ hr.
15	♂	79·68	0·19	0·18
	♀	76·2	0·16	
25	♂	53·3	0·38	0·33
	♀	75·52	0·28	
30	♂	59·2	0·43	0·48
	♀	27·7	0·52	
40	♂	81·66	0·48	0·48
	♀	93·1	0·48	

* Each value is the mean of 4 to 6 estimations.

increases. For example, the μg. of dye reduced/ mg./hr. is 0·18 at 15° C and is 0·48 at 30° C. However, there is only negligible increase in activity when the temperature is raised from 30° to 40° C. However, the maximum activity appears to be around 34° C as can be seen from the values given in Table II (Average for the whole animal 0·59 μg. dye reduced/ mg./hr. at 34° C). As the higher lethal level for these animals is about 35° C it is possible there is tissue deterioration beyond this temperature and activity of the respiratory enzyme ceases.

TABLE II

The succinic dehydrogenase activity in different regions of the body of Branchinella *at room temperature (34° C)*

No.	Wet weight (mg.)	μg. of dye reduced/ mg./hr.
	Head	
1	8	0·75
2	9·5	0·56
3	10	0·5
4	10	0·5
5	21	0·43
Mean	11·7	0·55
	Throax	
1	39	0·82
2	44	0·75
3	46	0·64
4	53	0·93
5	56	0·73
Mean	47·6	0·77
	Abdomen	
1	15	0·5
2	16	0·5
3	17	0·6
4	20	0·25
5	24	0·42
Mean	18·4	0·45

The succinic dehydrogenase activity is higher in the muscles of the thoracic region than those of the head and abdomen (Table II). The thoracic appendages, which produce the feeding currents, show constant movement even while the animals are resting at the bottom of the glass troughs in the laboratory. Further, the respiration of these animals takes place mainly through these appendages. It is therefore presumed that the continuous activity of these appendages combined with their respiratory function cause these tissues to be deeply stained by T.T.C. indicating thereby intense enzymatic activity. Similarly, the head region reduces a greater amount of the dye than the

abdomen as the former possess actively moving head appendages. In the case of the freshwater mussel *Lamellidens marginalis*[3] it was found that the heart tissue which shows high activity was more deeply stained by T.T.C.

A comparison with other freshwater animals such as the rotifer *Conochilus madurai*[4] and the freshwater shrimp *Caridina nilotica*[5] also suggests that there is a relation between muscular activity of the animal and tissue respiration.

We thank Dr. S. V. Job for a critical reading of this paper.

Dept. of Zoology,   R. BERNICE SARA.
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MORPHOLOGICAL STUDIES IN *MYRIOPHYLLUM INTERMEDIUM* DC.

PREVIOUS literature pertaining to the embryology of the genus *Myriophyllum,* of the family Haloragaceæ, is very scanty, but for the works of Stolt (1928)[3] and Souèges (1940).[2] *Myriophyllum* is an aquatic, perennial herb with slender branched floating stems bearing two types of leaves. The flowers are borne in the axils of the emersed leaves forming dichasial clusters and are polygamous. The genus *Myriophyllum* is represented by two species in South India,[1] namely *Myriophyllum intermedium* DC., and *M. indicum* Willd. The present note deals with the sporogeneses and the development of male and female gametophytes in *M. intermedium* DC.

In a transverse section the young anther is four-lobed. A plate of densely cytoplasmic, hypodermal archesporial cells is differentiated in each lobe (Fig. 1). Each archesporial cell divides periclinally to form an outer primary parietal cell and an inner primary sporogenous cell (Fig. 2). The anther wall consists of an epidermis, an endothecium, 2–3 middle layers and a glandular tapetum, the cells of which occasionally become two-layered in certain places by division and remain uninucleate throughout (Fig. 3). During later stages the tapetal cells enlarge and degenerate when the pollen grains are at the uninucleate stage and

will be completely absorbed at the time of dehiscence of the anther. The middle layers also degenerate and the endothecial cells enlarge radially and develop fibrous thickenings (Fig. 7). The epidermis becomes discontinuous at certain places and consequently the endothecium is exposed externally at such regions. The primary sporogenous cells divide to form the microspore mother cells which enlarge and undergo meiotic divisions followed by simultaneous type of cytokinesis to form tetrahedral and also decussate tetrads of microspores (Figs. 4 and 5). The pollen grains are 4- to 5-rupoidate and aspidote with thick exine and thin intine. They are shed at the three-celled stage (Fig. 6).
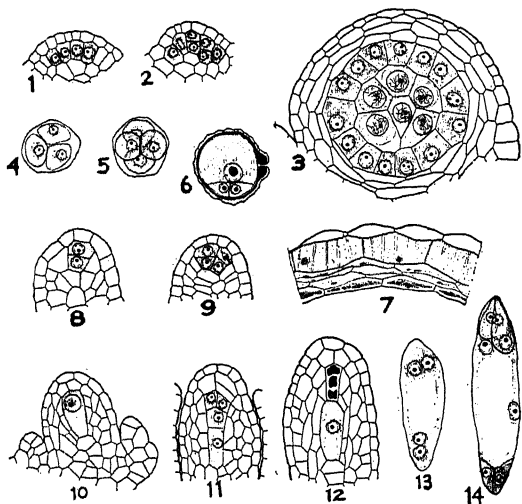
FIGS. 1-7. *Microsporangium and the male gametophyte.* Fig. 1. Transverse section of a young anther showing hypodermal archesporial cells, × 1,455. Fig.2. T.S. of a young anther showing archesporium dividing to form the primary parietal layer and the primary sporogenous layer. ×1,455. Fig. 3. T.S. of a microsporangium showing uninucleate tapetal cells and microspore mother cells, × 1,455. Fig. 4. Tetrahedral tetrad of microspores, × 2,182. Fig. 5. Decussate tetrad of microspores, × 2,182. Fig. 6. Three-celled pollen grain, × 2,182. Fig. 7. Fibrillar endothecium, × 1,455. Figs. 8-14. *Megasporangium and the female gametophyte.* Fig. 8. Archesporium dividing to form a parietal cell and a sporogenous cell, × 1,455. Fig 9. Two-celled archesporium after the formation of parietal cells and sporogenous cells, × 1,455. Fig. 10. Megaspore mother cell, × 1,455. Fig. 11. T-shaped tetrad of megaspores, × 1,455. Fig. 12. Functional megaspore, × 1,455. Fig. 13. Four-nucleate embryosac, × 1,455. Fig. 14. Eight-nucleate embryosac, × 1,455.

The ovary is inferior, four-carpelled, four-loculed, syncarpous with a single anatropous, bitegminal and crassinucellar ovule in each locule. Usually one hypodermal archesporial cell differentiates in the young ovule before initiation of the integuments (Fig. 8); rarely

two to three archesporial cells are seen (Fig. 9). However, only one functions during later stages. The archesporial cell divides into a parietal cell and a sporogenous cell (Figs. 8 and 9). The former undergoes one or two periclinal divisions, while the latter enlarges into megaspore mother cell (Fig. 10) which by meiotic divisions usually gives rise to a linear tetrad of megaspores (Fig. 12). Occasionally obliquely T-shaped or T-shaped (Fig. 11) tetrads of megaspores are formed. The upper three megaspores invariably degenerate and the chalazal one functions (Fig. 12). The nucleus of the functional megaspore undergoes three successive mitotic divisions to give rise to an eight-nucleate embryosac of the Polygonum Type (Figs. 13 and 14). The polar nuclei usually fuse in the centre of the embryosac before fertilization to form the secondary nucleus. The synergids degenerate after fertilization while the antipodals persist even after fertilization.

My thanks are due to Professor M. Nagaraj for his guidance and to Messrs. T. Thathachar and A. Sheriff for helpful suggestions.

Department of Botany,   B. H. M. NIJALINGAPPA.
Central College,
Bangalore-1, *October* 3, 1966.

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2. Souèges, R., "Embryogénie des *Haloragacées.* Développement de l'embryon chez le *Myrioyhyllum alternifolium* DC.," *C. R. Acad. Sci.,* Paris, 1940, 211, 185.
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CHROMOSOME STUDIES IN DIPLOPODA (MYRIAPODA)

A Note on the Abnormal Sex-Chromosome Behaviour in the Male of *Thyropygus* Sp.

THE chromosomal cytology of *Thyropygus* sp. reveals a diploid complement of 24 acrocentric chromosomes including a pair of XY sex-chromosomes in the male (Chowdaiah, 1966 a, b).[1-2] The first meiotic division is reductional for both the autosomes as well as the sex-chromosomes, the latter exhibiting lagging (Fig. 1). The second division is equational for all the chromosomes, the behaviour of the sex-chromosomes being normal.

A quite unorthodox behaviour of the sex-chromosomes among a few cells of the male revealing the probable "co-existence of both pre-reduction and post-reduction" in the same

species is interesting. Such instances appear to be rare among the invertebrates, although there are several instances of such a possibility among certain vertebrates (White, 1954).[6] Among the large number of normal cells observed, there is a precocious splitting of X and Y in a few cells. In the first meiotic division, the end-to-end conjugation of the partners in each of the XY-complex is clearly seen (Fig. 2). Later on, the completely split halves of the X and Y separate giving rise to two identical bodies on each side which begin to move towards each pole (Figs. 3, 4). Thus, the completion of the first meiotic division and the subsequent stages clearly reveal an unusual equational division for the XY-complex (Figs. 5, 6). However, the fate of these cells is yet to be understood in the light of further investigations.
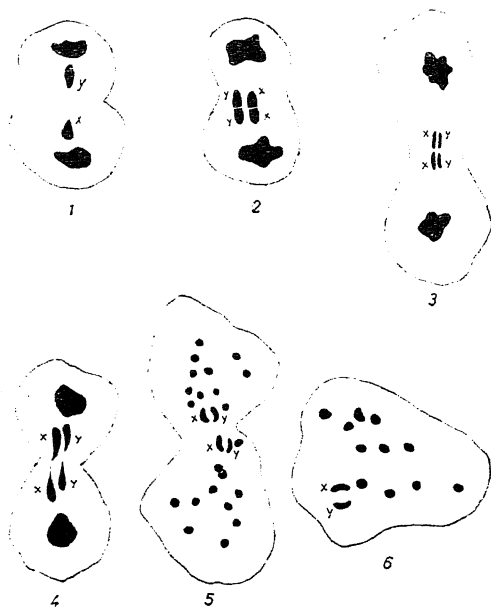
FIGS. 1-6. *Thyropygus* sp. Fig. 1. Normal type of segregation of sex chromosomes prevalent in the species. Fig. 2. Sex-chromosomes show precocious splitting and chromatids in each show end-to-end attachment. Fig. 3. The completely split halves of X and Y begin to move towards the poles. Fig. 4. Telophase I, showing the regular passage of the daughter chromatids of X and Y towards the poles. Fig. 5. Sister groups of Anaphase I, showing in each the XY-sex complement. Fig. 6. Polar view of Metaphase II, showing the XY-sex complement, × 3,200.

Presuming that the XY-complex disjoins in the second meiotic division as in the case of some Chilopods (Ogawa, 1950),[4] the present demonstration of the regular passage of the daughter chromatids of the sex-chromosomes in

the first meiotic division provides evidence as to the correctness of the probable co-existence of both pre-reduction and post-reduction of the sex-chromosomes in the same species, even though its significance is yet unknown. Probably, an abnormality at the time of division of the centromeres of the sex-chromosomes is the basis of the unusual event described above as reported in the case of Cotton Stainer (Ray-Chaudhuri and Manna, 1952).[5] It is also possible, that since the post-reduction is the 'older' and more 'primitive' mode of reduction, it has arisen several times in the evolution of many natural populations (Halkka, 1956).[3]

Thanks are due to Prof. B. R. Seshachar for guidance and encouragement during the course of this investigation.

Department of Zoology,   B. N. CHOWDAIAH.
Central College,
Bangalore, *November* 29, 1966.

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XENOCARPY IN *MOMORDICA DIOICA* ROXB.

Momordica dioica Roxb. is a diœcious plant as the name indicates. It produces a vegetable which is considered a delicacy. The normal habitat of the plant is scrub jungle but it is often planted in the garden. In our city garden there was a female plant and there was no male plant. The female plant flowered profusely but the unpollinated ovaries turned yellow and dried up in about 20 days.

With a view to seeing the effect of foreign pollen on the development of the ovary, the flowers of *Momordica* were pollinated with pollen of *Luffa acutangula* Roxb. and *Cucurbita pepo* Dc. and *Cucumis sativus* L. Both *Momordica* and *Luffa* flower in the evening, *Momordica* at about 7 p.m. and *Luffa* at about 5 p.m. while *Cucurbita* and *Cucumis* flower in the morning. When *Luffa* pollen was used for pollinating *Momordica* stigma at 8-30 to 9 p.m. the stigma was young and fresh while in the case of *Cucurbita* and *Cucumis* pollens, used in the mornings, the *Momordica* stigmas were 12 hours old. Although these stigmas looked

fresh, pollination with *Cucurbita* or *Cucumis* pollens had no visible effect on growth. The pollinated ovaries remained green longer than the unpollinated ones but no growth was perceptible. This may be an indication that the stigmas in these cases had lost their receptivity. In the case of pollination with *Luffa* pollen, there was growth of the ovary in every case.

The *Momordica* ovary has an inverted pear shape, the thickest portion being towards the stalk. The ovary at the time of flowering in the plant under consideration has the maximum diameter of 0·2 to 0·3 cm. When pollinated with *Luffa* pollen the ovaries grew to a diameter of about 1 cm., being a little over 1 cm. in some cases in 15 days. At this stage, growth stopped and ovaries turned yellow and ultimately in 20-25 days the ovaries dried up. The process was repeated 13 times and in every case the result was the same.

This may indicate that the fruit growth has two stages, one promoted by the pollen and the other by the fertilised ovule. This confirms Swingle's suggestion in the case of the date fruit.[1]

It is proposed to try the effect of growth hormones at this stage next season.

10, Cantonment Road,   P. PARIJA.
Cuttack-1, *December* 18, 1966.

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INHERITANCE OF MOSAIC RESISTANCE IN SUGARCANE*

MOSAIC disease of sugarcane, caused by a virus, is one of the most widely distributed of the sugarcane diseases. The characteristic symptoms of the disease are mottling of the leaves resulting in loss of chlorophyll. The disease has been known to cause losses in yield and has been responsible for the failure of certain important commercial varieties. The most effective control of the disease can be only through development of resistant varieties.

During the last decade, the disease has assumed importance in India and breeding resistant varieties have been in the programme of work at this Institute. Under Coimbatore conditions there is considerable natural transmission of the disease, the maximum spread being from June to August. This indirectly affords an opportunity to screen parental stocks and seedlings for the disease under natural incidence conditions. Artificial screening is also done.

One of the hybrid varieties of U.S. origin, U.S. 49-7, has shown considerable resistance to mosaic disease under natural conditions for a period of 3-4 years while another U.S. clone, C.P. 29-320, has recorded susceptibility. One of the seedlings resulting from a cross of the two clones recorded high resistance to the disease under natural conditions. In order to understand the pattern of inheritance of the disease, this seedling was back-crossed to both the parents and the resultant 77 seedlings with the resistant parent and 70 with the susceptible parent were studied for resistance to the disease under natural conditions. Data recorded during the months of June to August when the infection is severe, indicate 14·5% of the seedlings as showing infection in the back-crossing programme with the resistant parent and 32·3% with the susceptible parent. From the nature of segregation of seedlings in these two back-crosses, assuming a two-factor duplicate genes R_1 and R_2 as governing resistance in a dominant fashion either individually or together, X^2 test was worked out to test the significance of the deviation of observed frequency from the expected on a 15 : 1 and 3 : 1 ratio respectively. Thus the heterozygosity of both alleles in the material as well as recessive alleles determining susceptibility was indicated. Further confirmation of this segregation basis came from the repeat cross and the immediate progeny segregation.

According to Azab and Chilton,[1] "inheritance of resistance to sugarcane mosaic is conditioned by complementary factors, resistance being dominant and a group of minor modifying genes controlling the expression of the disease. Irregularities in the behaviour of *Saccharum spontaneum* chromosomes during meiosis in sugarcane varieties also influence the transmission of the disease". Though the suggestion of complementary genes functioning does not fit into the present finding, it is clear that resistance is dominant and transmissible from parent to progeny.

Thanks are due to Dr. T. N. Krishnamurthy for assistance in writing this note.

Sugarcane Breeding Institute,   G. R. SINGH.
Coimbatore, *August* 25, 1966.

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REVIEWS AND NOTICES OF BOOKS

Elementary Partial Differential Equations. By Paul W. Berg and James L. McGregor. (Holden-Day, Inc., 500, Sansome Street, San Francisco), 1966. Pp. xv + 421. Price $ 13.00.

The aim of this book is twofold : to provide students with the techniques necessary for the formulation and solution of problems involving partial differential equations in courses in other disciplines ; and to prepare students for further study in partial differential equations and linear analysis by furnishing a basis for "intuition" in these subjects. It is well suited for use by students in mathematics, the physical sciences, and engineering, at levels varying from the sophomore to the first year graduate.

The first three chapters constitute an introduction to partial differential equations in general, to the classification of linear partial differential equations with constant coefficients, and to the formulation of a large class of typical problems of mathematical physics. Chapters 4 through 7 develop a unified method of solution of the problems—the method of spectral representation, with separation of variables serving as the procedure for determining the appropriate spectral representation. In the remaining chapters the scope of this procedure is extended to a wider class of problems. Problems discussed include a variety of typical problems, for the heat equation, the wave equation, Laplace's equation, and related equations, in finite and infinite domains.

C. V. R.

Number Systems of Analysis. By G. Cuthbert Webber. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. x + 213. Price $ 6.00.

The primary objective of this text is to provide a development of the real number system coverable in one semester. The book also includes an extension to the complex numbers. A modification of the Peano postulates is used as the starting point, and Cauchy sequences are employed in the transition from rationals to reals. The material on Cauchy sequences is designed to lend itself to a discussion of the distinction between proof construction and proof presentation.

As a means of teaching young students how to develop their own proofs, transitions from one subsystem to another are motivated, as are individual steps in proofs. A mathematical maturity gained in two or three semesters of college mathematics is the only prerequisite.

C. V. R.

The Analytic S-Matrix—*A Basis for Nuclear Democracy***.** By Geoffrey F. Chew. (W. A. Benjamin, Inc., New York and Amsterdam), 1966. Pp. ix + 103. Price $ 8.80.

This text-monograph is a systematic presentation of strong interaction dynamics on the basis of the S-Matrix, without appeal to field theoretical notions. Emphasis is on fundamental principles suitable for a graduate student approaching the subject of high energy nuclear physics for the first time. The central point of the book is "maximal analyticity of the second degree," which is equivalent to the concept of nuclear democracy and which constitutes the basis for bootstrap dynamics.

The pole-particle and branch point-threshold correspondence are introduced immediately, and the analytic continuation of unitarity through discontinuity formulas is introduced at an early stage and recognized as providing the basis for dynamics. The author assumes familiarity with the principles of non-relativistic quantum mechanics (including scattering theory) as well as with the Lorentz group, but no background in quantum field theory is required. This book is a report on recent research on the concepts previously described in the author's *S-Matrix Theory of Strong Interactions.*   C. V. R.

The Railroad and the Space Program.—*An Exploration in Historical Analogy.* Edited by Bruce Mazlish. (The M.I.T. Press, Cambridge, Mass. 02142), 1965. Pp. ix + 223. Price $ 7.50.

The scope of the book is indicated by the titles of the chapters given below : I. Historical Analogy : The Railroad and the Space Program and Their Impact on Society, by Bruce Mazlish ; II. A Technological Frontier : The Railway, by Thomas Parke Hughes ; III. Railroads as an Analogy to the Space Effort : Some Economic Aspects, by Robert William Fogel ; IV. The Economic Impact of the Railroad Innovation, by Paul H. Cootner ; V. The Railroads : Innovators in Modern Business Administration, by Alfred D. Chandler, Jr., and Stephen Salsbury ; VI. The

Social Impact of the Railroad, by Thomas C. Cochran; VII. Political Impact: A Case Study of a Railroad Monopoly in Mississippi, by Robert L. Brandfon; VIII. The Impact of the Railroad on the American Imagination, as a Possible Comparison for the Space Impact, by Leo Marx.   C. V. R.

Molecular Relaxation Processes. (Academic Press, London and New York), 1966. Pp. ix + 304. Price 65 *sh.*

This volume records the lectures delivered and papers read at the Chemical Society Symposium on Molecular Relaxation Processes held at Aberystwyth in July 1965, together with, in many cases, the discussions which ensued. It provides a broad account of both practical and theoretical aspects of this important region where Chemistry, Physics and Mathematics overlap, and will appeal to scientists active in each of these sciences.   C. V. R.

Electron Microscopy (Second Edition). By E. H. Mercer and M. S. C. Birbeck. (Blackwell Scientific Publications Ltd., 5 Alfred Street, Oxford). Pp. 102. Price 12 *sh.* 6 *d.* net.

The object of this little hand-book is to provide a set of instructions for biologists to prepare specimens for electron microscope examination. The first edition of 1961 was well received. In the revised second edition a number of new methods of fixing, staining and embedding have been added. A practical guide book for biologists and cytologists whose work demands use of electron microscope.   A. S. G.

Books Received

Elementary Principles of Plant Breeding. By H. K. Chaudhari. (Jaipur Printers, Jaipur), 1966. Pp. xii + 292. Price Rs. 10.

Topological Groups (2nd Edition). By L. S. Pontryagin. Translated from the Russian by Arien Brown (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York), 1966. Pp. xv + 543. Price: Reference Edition $ 32.50; Professional Edition $ 17.50.

The Harvey Lectures (1964-1965). Series 60. (Academic Press, 111, Fifth Avenue, New York), 1966. Pp. xiv + 314. Price $ 9.50.

Introduction to Nuclear Physics. By Harald A. Enge. (Addison-Wesley Publishing, Co., Inc., Reading, Mass.), 1966. Pp. x + 582. Price $ 3.75.

Calculus (Part I). By Edwin E. Moise. (Addison Wesley Publishing Co., Inc., Reading, Mass.), 1966. Pp. ix + 498. Price $ 6.75.

ANNOUNCEMENTS

Award of Research Degrees

Andhra University has awarded the Ph.D. degree to the following : Sri. Y. K. Sarat Chandra Babu (Physics); A. V. Suryanarayana Murty (Geophysics); Sri. C. Srinivasulu (Chemistry); Sri. J. Subrahmanyam (Chemistry); Sri. R. V. Vaidyanadhnayyar (Chemistry); Sri. N. Kurmaiah (Chemistry); Sri. N. Krishnamurty (Chemistry); Sri. D. V. Rama Sarma (Zoology); Sri. M. Krishna Rao (Botany); Sri. CH. Durgaprasada Rao (Technology).

Osmania University has awarded the Ph.D. in Mathematics to Sri. M. Gopalakrishna Murthy.

Sri. Venkateswara University has awarded the Ph.D. degree in Mathematics to Sri. V. V. Subrahmanya Sastri.

Utkal University has awarded the Ph.D. degree in Chemistry to Sri. P. C. Rath.

Punjabi University, Patiala, has awarded the Ph.D. degree in Physics to Sri. Mohinder Singh.

Lady Tata Memorial Trust Scientific Research Scholarships, 1967-68

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 300 each per month for the year 1967-68 commencing from 1st July 1967. Applicants must be of Indian nationality and *Graduates in Medicine or Science* of a recognised university. The age limit is 27 years on the closing date for applications which is 15th March 1967. Candidates can obtain further particulars and other information they desire from the Secretary, Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

Natural Rubber Conference, 1968, Kuala Lampur, Malaysia

A Conference on Natural Rubber Research and Development, organised by the Rubber Research Institute of Malaya on behalf of the Malayan Rubber Fund Board, will take place in Kuala Lumpur, Malaysia, from Wednesday, 28 August to Thursday, 5 September 1968.

The Conference will cover the broadest aspects of natural rubber production processing and manufacture, and is expected to attract a number of overseas delegates. There will be no Planters' Conference during the 1968 but planters will receive invitations to attend those sessions of the Conference that will be of interest to them. An Information Bulletin giving further details of the Conference will be issued later.

Marine Biological Association of India

The third in the series of symposia on Mollusca will be held from 12 to 16 January 1968 at Cochin/Ernakulam.

The Association invites contributions from scientists all over the world on the following subjects: Taxonomy, Phylogeny and Evolution; Distribution, Morphology and Anatomy; General Biology, Radiation Biology, Reproduction, Early Development, Ecology and Behaviour; Physiology, Boring and Fouling Molluscs; Parasitism and Commensalism; Culture, Economics and Fishery; and Review. Background papers on the above subjects are also invited.

The titles of contributions for the Symposium will be registered up to March 15, 1967. Abstracts of papers in about 250 words, in duplicate, should reach the Convener by April 30, 1967 and the full papers (typescripts in duplicate) by June 30, 1967.

All correspondence may be addressed to: The Convener, Symposium on Mollusca, Marine Biological Association of India, Mandapam Camp, Ramanathapuram District, Madras State, India.

International Biological Programme—Indian Conference

A Conference of leading biologists in the country will be held in New Delhi on the 23rd, 24th and 25th February 1967, under the Chairmanship of Prof. B. R. Seshachar, Professor and Head of the Zoology Department, University of Delhi, Delhi-7. The objective of the Conference is to concert measures to implement the International Biological Programme. The rapidly increasing human population and the wide extent of malnutrition, specially in underdeveloped countries, call for greatly increased food production coupled with rational management of natural resources. This can be achieved only on the basis of scientific knowledge, which, in many fields of biology and in many parts of the world, is at present wholly inadequate. At the same time, human activities are creating great changes in the environment. The IBP sets out to promote basic knowledge relevant to the needs of man. Obviously this can be done only by a world-wide plan of research concerned with "Biological Basis of Productivity and Human Welfare".

The Conference in New Delhi will discuss the measures by which India can participate in the programme.

International Symposium on Protein Foods and Concentrates

The Symposium will be held at the Central Food Technological Research Institute, Mysore (India), from June 27 to July 4, 1967. The Symposium has been sponsored by the Council of Scientific and Industrial Research, New Delhi, in co-operation with the National Institutes of Health, U.S.A. and the Association of Food Technologists, India. International agencies like FAO, WHO and UNICEF are being invited to participate in it as co-sponsors.

Invitation to participate in the Symposium is extended to specialists from research organizations and industries in India and abroad specialising in science and technology of protein foods.

The last date for receipt of abstracts of paper (in duplicate) is March 31, 1967 and full papers (in duplicate) is May 1, 1967. Those interested can obtain further information from Dr. B. L. Amla or Dr. T. N. R. Rao, Secretaries, International Protein Symposium, Central Food Technological Research Institute, Mysore-2, India.

Summer School in High Voltage Laboratory Techniques, 8-20 May 1967

The High Voltage Laboratory of the Indian Institute of Science, Bangalore, proposes to conduct a Summer School, from 8th to 20th May, 1967. The course will cover basic principles of high voltage production, measurement and testing techniques supported by appropriate experiments and demonstrations. One of the objects of the school is to give those who attend a real working knowledge of high voltage application. Morning sessions will be devoted to theory and demonstrations; laboratory practice lessons will be held in the afternoons. There will be 26 lectures of one-hour duration each and 31 hours of laboratory practice to be concluded by a discussion meeting at the end of the course.

In order to maintain the highest standards, the enrolment to the Summer School will be limited to a small number whose qualifications and experience suggest that they will receive the most benefit from the programme.

Tuition fee is Rs. 500 and is payable upon notification of admission to the Registrar, Indian Institute of Science, Bangalore-12, from whom further information may be obtained.

NEW TYPE OF C-GLYCOSIDES OCCURRING IN NATURE

V. K. BHATIA AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

A LARGE number of glycosides, which were earlier isolated from natural sources and studied, were O-linked glycosides; in these, the sugar portion is linked to the aglycone through the oxygen of a phenolic or an alcoholic hydroxyl group. In the study of nucleic acids and the derived nucleosides and subsequently in the study of coenzymes, N-linked glycosides came to be recognised as of common occurrence. Recently glycosides of a novel and stable type have been discovered and these are distinguished by a direct C–C link between the sugar and non-sugar part. Some of these compounds have been known for over a hundred years in the crystalline condition, but it is only during the past ten years that their special nature has been understood. The new type of compounds are called C-glycosyl compounds or C-glycosides. They are rapidly increasing in number and they seem to occur widely. The aglycones involved belong to different types and so far representatives have been found in the groups of anthrones, anthraquinones, flavones, flavonols, flavanones, dihydrochalkones, isoflavones, xanthones and isocoumarins.

The earliest review on this subject was by Hörhammer[1] and a later one by Haynes[2] was more comprehensive. In view of the rapid advances made in this field there is need for frequent reviews. The present article deals with the developments in this field after the review of Haynes. C-Glycosides whose study is fairly complete are briefly described below. They are grouped on the basis of their aglycones for convenience of discussion.

1. ANTHRONE DERIVATIVES

Barbaloin, isobarbaloin, homonataloin and cascarosides A and B and related compounds belong to this group. Barbaloin (I c), one of the earliest known C-glycosides, was isolated in 1851 from the Cape aloes, *A. ferox* and *A. perryi* and Curacao aloes, *A. vera*. It is 9-β-D-glucopyranoside of aloe-emodin anthrone and is accompanied by the α-isomer, isobarbaloin. It has recently been synthesised by condensing aloe-emodin anthrone (I a) and tetra-O-acetyl-α-D-glucopyranosyl bromide (I b). *Aloe speciosa* contains homonataloin, which is 9-D-glucopyranosyl-4, 6-dihydroxy-5-methoxy-2-methyl anthrone. Four aloin-like substances have been isolated from

the purgative drug, cascara bark obtained from *Rhamnus purshiana*. Of these, cascarosides A and B seem to be 4- or 5-O-glycosides of barbaloin.[2]
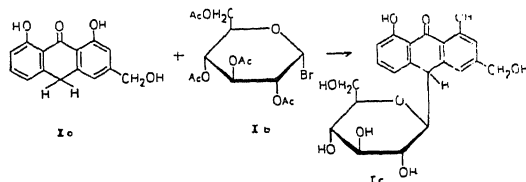
CHART I

2. ANTHRAQUINONE DERIVATIVES

Carminic Acid is the only known anthraquinone C-glycoside and occurs in *Dactylopius coccus* Costa. Its structure has been recently revised to (I d) after the synthesis of degradation products and the NMR spectral studies.[3,4]
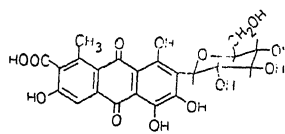
1 d

CHART II

3. FLAVONE AND FLAVONOL DERIVATIVES

(i) *Vitexin (Orientoside)* was the first C-glycoside to be studied in detail. Recently its isolation has been reported from *Acer palmatum*[5] and *Tamarindus indica*.[6,7] It was originally considered to be apigenin-8-glucofuranoside.[2] The proof that formic acid is a product of periodate oxidation of vitexin by two groups of workers[8,9] has led to the establishment of its correct structure as apigenin-8-β-glucopyranoside (II). This has been supported by NMR spectral studies.[9] Vitexin-4'-rhamnoside occurs in *Cratægus oxyacantha* and *Vitex lucens*.[2] The position of linkage of the rhamnose moiety is unknown.

Isolation of O-D-xylosyl vitexin from *Vitex lucens* and *Citrus sinensis* and p-hydroxybenzoyl vitexin from *Vitex lucens* has been reported.[10] On the basis of NMR spectral studies they have been assigned the constitutions of 2″-O-β-D-xylopyranosyl vitexin (III) and 2″-(p-hydroxy benzoyl) vitexin (IV), the new groups are attached to the concerned alcoholic hydroxyl group in the C-glycosyl part.

(ii) Isovitexin (saponaretin, homovitexin) (V) has also been lately isolated from *Tamarindus indica*.[6,7] It was originally considered to be apigenin-8-C-glucoside with sugar in the open chain form.[2] On the basis of the NMR spectral studies, Horowitz and Gentili[9] have shown that in this compound the β-D-glucopyranose is attached at the 6-position of apigenin. It also occurs as its xyloside and rhamnoside,[2] the position of linkage of these sugars being unknown. Isovitexin-7-methyl ether has been isolated from *Swertia japonica*.[11]
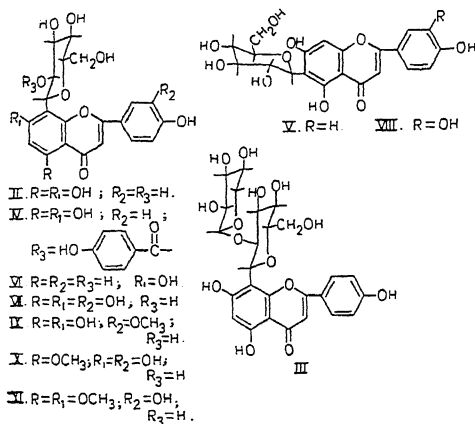
CHART III

(iii) Saponarin and Isosaponarin.—Saponarin which was earlier isolated from various woods[2] has been recently found to occur in various grasses also.[12] It and isosaponarin are the 7- and 4'-O-glucosides of isovitexin respectively.

(iv) Bayin occurs in the mature heart-wood of *Castanospermum australe*. Its structure as 5-deoxyvitexin was earlier established by the conversion of 7, 4'-di-O-methylvitexin tetraacetate into 7, 4'-di-O-methylbayin by the removal of the 5-hydroxyl group.[2] Because of the recent revision of the structure of vitexin, the revised structure of bayin, should be (VI). This has also been supported by the later degradation studies of Eade and co-workers[13] and NMR spectral studies.[14]

(v) Orientin (lutexin) seems to be very widely distributed and has also been isolated from the leaves of *Acer palmatum*,[5] *Helichrysum bracteatum*[15] and *Tamarindus indica*.[6,7] It was earlier considered to be luteolin-8-glucofuranoside.[2] Koeppen[16,17] found that it consumed 2 moles of periodic acid with the formation of 1 mole of formic acid. The nature of the sugar moiety as glucose was shown by ferric chloride oxidation. On the basis of the above data and NMR spectral studies,[18] orientin

has been shown to be luteolin-8-β-gluco pyranoside (VII).

Recently Seshadri and co-workers[19-21] have reported the isolation of an epimer of orientin from the leaves of *Parkinsonia aculeata*. This compound (epi-orientin) resembles orientin in chemical composition and reactions, chromatographic behaviour, UV and IR spectra. Periodate oxidation of epi-orientin tetramethyl ether leads to the formation of 8-formyl-5, 7, 3', 4'-tetramethoxy flavone. Since orientin is luteolin-8-β-glucopyranoside, epi-orientin should be luteolin-8-α-glucopyranoside.

(vi) Iso-orientin (Homo-orientin, Lutonaretin) has been found to occur in a number of new sources also, e.g., *Helichrysum bracteatum*,[15] *Tamarindus indica*[6,7] and *Swertia japonica*.[11] It was earlier considered to be luteolin-8-C-glucoside with the sugar in open chain form. Periodate and ferric chloride oxidations and NMR spectral studies have led to its structure as luteolin 6-glucopyranoside (VIII). In view of its isomeric relationship, Seshadri and co-workers have suggested that the name homo-orientin may be dropped and iso-orientin[7] used instead.

It also occurs as its xyloside called adonivernoside in *Adonis vernalis*. Iso-orientin 7-O-glucoside (lutonarin) has been isolated from barley leaves along with its 3'-methyl ether.[2] Iso-orientin-7-methyl ether has been found to occur in *Swertia japonica*.[11]

(vii) Scoparin (Scoparoside).—Only a few methyl ethers of C-glycosides have been found to occur in nature and they usually accompany the parent hydroxy compounds. Scoparin, one of the earliest methyl ethers of this type to be isolated, occurs in *Sarothamnus scoparius* and is considered to be orientin-3'-methyl ether based on degradative studies.[2] Because of the recent revision of the structure of orientin, it should have the revised structure (IX).

(viii) Parkinsonin-A and Parkinsonin-B.—The two compounds have been isolated along with epi-orientin from *Parkinsonia aculeata* by Seshadri and co-workers.[19-21] Both were found to be stable to acidic and enzymatic hydrolysis and on fission with hydriodic acid gave luteolin. Sodium borohydride reduction of the periodate oxidised products of their methyl ethers followed by hydrolysis with acid yielded glycerol. This reaction is given not only by O-glycosides but also by commonly occurring C-glycosides.[6] These methyl ethers consumed 2 moles of periodate with the liberation of 1 mole of formic acid and oxidation with ferric chloride yielded glucose. The above data and

spectral studies lead to the conclusion that parkinsonin-A and parkinsonin-B are 8-β-glucopyranosyl luteolin-5-methyl ether (X) and 8-α-glucopyranosyl luteolin-5, 7-dimethyl ether (XI) respectively.

(ix) *Lucenin-1 and Violanthin.*—Recently the existence of di-C-glycosides has been noted. Lucenin-1 was isolated from *Vitex lucens* by Seikel and Mabry.[22] Based on its properties, stability to acidic hydrolysis, its chromatographic behaviour UV and NMR spectral studies it is considered to be luteolin 6, 8-diglucosyl derivative. This source seems to contain many more members of this group.[23] The isolation of another di-C-glycoside, violanthin (6, 8-diglycoside of apigenin) has been reported by Hörhamer and co-workers[24] from *Viola tricolor* (garden variety). One of the sugars involved might be rhamnose.

C-glycosyl flavones (6- or 8-C-glycosyl derivatives of apigenin and luteolin) form the dominant flavonoids of the vegetative parts of a wide variety of plants; their occurrence is therefore considered to be useful for taxonomy.[25]

(x) *Keyakinin and Keyakinol.*—Keyakinin is considered to be rhamnocitrin-6-C-arabinoside and if correct will be the only flavonol-C-glycoside known.[2] However, according to Harborne,[26] the structural evidence is not conclusive; it is more in favour of its being a flavone than a flavonol. Keyakinol is dihydrokeyakinin.

4. FLAVANONES

Hemiphloin and Isohemiphloin.—These two compounds were isolated from the kino gum of *Eucalyptus hemiphloia* and the former was originally assigned the structure of naringenin-8-C-glucoside with sugar in the open chain form. Based on its colour reactions, spectral studies and conversion into isovitexin by iodine-oxidation (dehydrogenation), its structure should be revised to naringenin-6-β-glucopyranoside. Isohemiphloin is very similar to hemiphloin and can be obtained from it by prolonged acid treatment and consequently is the position isomer, i.e., 8-C-glucopyranoside.

5. DIHYDRO CHALKONES

Asphalathin.—This compound, isolated from *Asphalathus acuminatus* was earlier considered to be a C-glycosyl derivative of eriodictyol. Detailed study of UV, IR and NMR spectra and periodic acid oxidation lead to the conclusion that it is 3'-C-β-D-glycopyranosyl derivative of 3-hydroxy phloretin and should be represented by (XII).[27a,b] It is the only representative of this group.
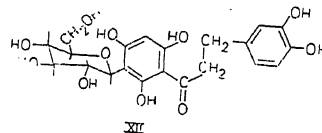
CHART IV

6. ISOFLAVONE DERIVATIVES

Puerarin.—Puerarin, daidzein-8-glucopyranoside, is the only known member of this group. It occurs along with its monoxyloside in *Pueraria thumbergiana*,[2] an important Chinese medicament.

7. XANTHONE DERIVATIVES

Mangiferin is the only representative of this group and has been known for a long time in the amorphous state but recently has been isolated in the crystalline condition from the leaves, unripe fruits, heart-wood and stem-bark of *Mangifera indica*,[2,28,29] *Anemarrhenæ rhizoma*,[30] and *Hedysarum obscurum*.[1] On the analogy of the structure of euxanthic acid, mangiferin was originally considered to be 7-O-glucoside of 1, 3, 6, 7-tetrahydroxy xanthone. However, since it is resistant to hydrolytic agents it appeared that it belongs to the new class of C-glycosides. That the sugar was D-glucopyranose was shown as follows. Aqueous ferric chloride oxidation of mangiferin gave D-glucose. Mangiferin trimethyl ether consumed 2·2 moles of periodic acid and liberated formic acid and when subjected to periodate oxidation (2 moles) and the resulting dialdehyde treated with sodium borohydride followed by acid hydrolysis gave glycerol.

The position of linkage as 2 was first surmised based on the activity of nuclear positions in tetrahydroxy xanthones and possible biogenesis of C-glycosides and was established by periodate oxidation of the tri-and tetramethyl ethers when the α-hydroxy acetaldehyde of xanthone methyl ethers were obtained as the major fission product. That it was the 2-α-hydroxy acetaldehyde was confirmed by unambiguous synthesis. Osmium tetraoxide oxidation of 1-hydroxy-3, 6, 7-trimethoxy-2-allyl xanthone yielded a diol which underwent periodate fission to yield a xanthone acetaldehyde and further oxidation with one mole of periodate formed the hydroxy acetaldehyde. Quite parallel results have been obtained using mangiferin tetramethyl ether, the resulting hydroxy acetaldehyde synthetically prepared starting from 1, 3, 6, 7-tetramethoxy-2-allylxanthone. Further evidence has been provided by subjecting the glycoside tetramethyl ether

to oxidation with neutral potassium permanganate whereby the tetramethoxy xanthone-2-carboxylic acid has been obtained.[31,32] Studies of the NMR spectra of mangiferin (XIII) and its derivatives fully support this formulation.[33] In the conversion of mangiferin into euxanthic acid in the animal system, the 3- and 6-phenolic hydroxyls as also the C-C linked glucose unit are obviously removed by a process of reduction involving specific enzymes.

8. Isocoumarin Derivatives

Bergenin (XIV) has been recently found to occur in *Bergenia cilliata, B. strechi,*[34] *Connarus monocarpus,*[35] *Corylopsis spicata* and *Vateria indica.*[36] Synthesis of bergenin was achieved by condensing tetra-O-acetyl-α-D-glucopyranosyl bromide with 4-O-methyl gallic acid in methanol in the presence of sodium methoxide, the O-glucosides formed being subsequently hydrolysed by acid.[2] A possible mode of its biosynthesis from 2-O-galloylarbutin (XV) has been suggested involving oxidation and methylation as shown in (XV) and (XIV).

XIII   XVI
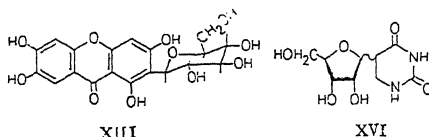
CHART V

XV   XIV
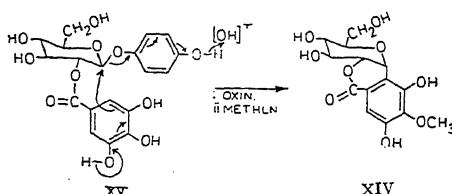
CHART VI

9. Pyrimidine Derivatives

Pseudouridine is a C-glycoside of uracil present in transfer ribonucleic acid and is represented as 5-β-D-ribofuranosyl uracil (XVI). 3,5-Diribosyl-uracil (5-β-D-ribosyl uridine), occurring in small quantities in certain strains of *E. coli* and of *Penicillium,* is considered to be the intermediate in the formation of pseudouridine. Its synthesis in very low yields was reported by Shapiro and Chambers[38] involving the coupling of 5-lithio-2,4-dimethoxypyrimidine (XVII) with 2,3,5-tri-O-benzoyl ribosylchloride (XVIII) followed by hydrolysis with dichloroacetic acid to remove the protecting groups. A modification of this synthesis was to condense 5-lithio-2,6-ditertiary butoxy pyrimidine with 2,3,4,5-di-O-benzylidine-D-ribose.

The removal of the protecting groups and ring closure of the sugar residue was carried out with aqueous methanolic hydrochloric acid.

XVIII   XVII
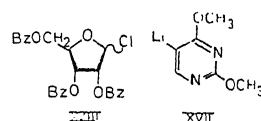
CHART VII

Biogenesis.—The formation of C-glycosyl compounds seems to involve a C-glycosylation process analogous to C-alkylation and can occur either before or after the synthesis of the aglycone; the former route would involve substitution in a poly-β-ketonic precursor. Although no strong argument in favour of one or the other route is available at present, the latter route, *i.e.,* C-glycosylation of the aglycone seems more probable and is supported by the recent synthesis of barbaloin and bergenin. The sugar residues of these substances are attached to highly anionoid centres in the aglycones, most probably as an ultimate step in the biosynthesis. The anion (XIX) of the phenolic aglycone by interaction with a derivative of a 1-phosphorylated sugar would furnish the O- and C-glycoside respectively in a manner exactly analogous to O- and C-alkylation.

XIX
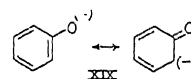
CHART VIII

On analogy with other C-C bond forming reactions in organic synthesis, it is conceivable that the glycosylation might, under physiological conditions, be directed towards an anionoid carbon atom as much as towards an oxygen atom. In this connection it is of biogenetic interest to note the co-occurrence in plants of many C-glycosyl derivatives with their O-glycosides.

The old type O- and N-glycosides undergo rapid hydrolysis in the digestive system of animals and their medicinal properties are thereby considerably affected. They have therefore to be administered by injection. This disability does not exist in the case of C-glycosides. They are generally stable to the action of digestive juices and can function as such in the system. However as mentioned in the case of mangiferin they can be made to undergo reductive cleavage in the animal body but at what site this happens and how, are points to be still investigated.

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A NUMERICAL TAXONOMICAL STUDY OF *ARTHROBACTER*

M. F. MULLAKHANBHAI AND J. V. BHAT

Fermentation Technology Laboratory, Indian Institute of Science, Bangalore-12

INCREASED interest in the use of the computers has led us to process the properties recorded of a large collection of freshly isolated cultures of *Arthrobacter* (170 strains) on a IBM 1620 computer. It may be pointed out here that the present-day trend in bacterial systematics is in the direction of recording as many properties of bacteria as possible on their morphology, physiology, nutrition and metabolism. In computing the similarity between two taxonomic entities, numerical taxonomy treats all the taxonomic characters as of equal value and importance. This approach to bacterial systematics has indeed yielded encouraging results in the hands of many investigators.

Among the recently reported investigations on the numerical taxonomy may be mentioned those of Liston,[1] Klinge,[2] Colwell and Liston[3] and Lysenko[4] on the Gram-negative psedoomonads and related forms and those of Focht and Lockhart[5] on the bacterial taxa of both Gram-positive and negative organisms, and of Hill,[6] Pohja and Gyllenberg,[7] Cheeseman and Berridge[8] and Sneath[9] on the Gram-positive genera. The taxonomy of even Streptomycetes has been examined by Silvestri *et al.*[10] and Hill and Silvestri.[11] Numerical taxonomy of the more difficult species as those represented by coryneform bacteria has also been carried out more recently by da Silva and Holt[12] and Harrington.[13]

The present report describes the procedure employed for computer analysis of data recorded for 170 strains of bacteria isolated from glycine enrichments in this laboratory. All the strains were identified as belonging to the genus *Arthrobacter*. A few strains, established by others as those of *Arthrobacter*, were also included in this study. Various characters employed in numerical taxonomy are recorded

TABLE II

The similarity matrix of 36 strains examined on the computer. The similarity values are expressed as percentages

	1	2	7	9	10	11	24	25	26	32	33	37	38	43	44	49	50	51	57	58	66	69	70	75	76	83	84	87	90	92	96	100	102	105	108	109
1	100																																			
2	100	100																																		
7	95	95	100																																	
9	62	62	60	100																																
10	62	62	60	100	100																															
11	65	65	62	95	95	100																														
24	68	68	65	91	91	95	100																													
25	68	68	65	91	91	95	100	100																												
26	68	68	65	91	91	95	100	100	100																											
32	72	72	69	87	87	91	86	86	86	100																										
33	72	72	69	87	87	91	86	86	86	100	100																									
37	70	70	76	80	80	83	86	86	86	91	91	100																								
38	70	79	76	80	80	83	86	86	86	91	91	91	100																							
43	73	73	70	74	74	76	80	80	80	84	84	91	91	100																						
44	73	73	70	74	74	76	80	80	80	84	84	91	91	100	100																					
49	46	46	44	42	42	44	40	40	40	50	50	50	50	51	51	100																				
50	54	54	52	62	62	65	68	68	68	58	58	58	58	53	53	37	100																			
51	54	54	52	62	62	65	68	68	68	58	58	58	58	53	53	37	100	100																		
57	74	74	74	68	68	71	67	67	67	77	77	77	77	85	85	48	50	50	100																	
58	74	76	71	68	68	71	67	67	67	77	77	77	77	85	85	45	50	50	96	100																
66	76	76	74	65	65	67	64	64	64	74	74	74	74	81	81	50	51	51	96	96	100															
69	65	65	62	60	60	62	65	65	65	69	69	69	69	64	64	41	83	83	59	59	61	100														
70	65	65	62	60	60	62	65	65	65	69	69	69	69	64	64	41	83	83	59	59	61	100	100													
75	62	62	60	76	76	80	76	76	76	80	80	73	73	67	67	42	69	69	68	68	71	73	73	100												
76	62	62	60	76	76	80	76	76	76	80	80	73	73	67	67	42	69	69	68	68	71	73	73	100	100											
83	57	57	55	53	53	55	51	51	51	61	61	61	61	57	57	48	50	50	58	58	60	60	60	72	72	100										
84	57	57	55	53	53	55	51	51	51	61	61	61	61	57	57	48	50	50	58	58	60	69	69	72	72	100	100									
87	57	57	55	58	58	60	57	57	57	60	60	60	60	62	62	60	50	50	63	63	60	53	53	58	58	53	53	100								
90	69	69	66	76	76	80	76	76	76	80	80	80	80	74	74	48	69	69	75	75	77	73	73	91	91	72	72	64	100							
92	60	60	57	76	76	57	60	60	60	64	64	64	64	65	65	44	66	66	60	60	62	80	80	68	68	56	56	50	68	100						
96	62	62	60	55	55	60	60	60	60	66	66	66	66	65	65	40	70	70	62	62	65	84	84	70	70	58	58	51	51	94	100					
100	62	62	60	57	57	60	62	62	62	62	62	66	66	57	57	47	65	65	59	59	61	70	70	66	66	60	60	48	66	80	84	100				
102	69	69	66	53	53	56	52	52	52	73	73	56	56	67	67	42	50	50	59	59	77	53	53	53	53	53	53	53	80	55	51	50	100			
105	65	65	62	70	70	73	69	69	69	83	83	73	73	67	67	44	58	58	81	81	67	56	56	73	73	55	55	45	65	51	53	74	80	100		
109	58	58	58	77	77	74	86	86	86	74	74	74	74	75	75	40	51	51	64	64	61	55	55	65	65	45	45	54	65	51	44	60	60	74	100	100

in Table I. The methods employed for determining these properties were essentially those recommended in the *Manual of Methods*[14] and reported earlier by Mullakhanbhai and Bhat.[15,16]

TABLE I

Properties used in the computer analysis for numerical taxonomy of Arthrobacter

1. Gram stain	25. Reduction of tellurite
2. Pleomorphism	26. Utilization of citrate
3. Fragmentation	27. Utilization of ammo-
4. Branching	nium salts
5. Motility	28. Utilization of phenol
6. Surface ring in broth	29. ,, benzoate
7. Pellicle in broth	30. ,, asparagine
8. Turbidity in broth	31. ,, glycine
9. Growth in NaCl at concentration of 5%	32. Changes in bromocresol-purple milk
10. Growth at 37°C.	33. Requirement of growth factors
11. Growth at pH 9·0	
12. Gelatin hydrolysed	34. Pigmentation
13. Starch hydrolysed	35. Acid from arabinose
14. Casein hydrolysed	36. ,, glucose
15. Tirosinase produced	37. ,, galactose
16. Arginine hydrolysed	38. ,, rhamnose
17. Urease produced	39. ,, fructose
18. Catalase produced	40. ,, glycerol
19. NH$_4$ from peptone	41. ,, mannitol
20. Trybutyrin hydrolysed	42. ,, sorbitol
21. H$_2$S produced	43. ,, raffinose
22. Nitrates reduced	44. ,, lactose
23. M.R. Positive	45. ,, maltose
24. Indole produced	46. ,, sucrose

For computing percentage similarity (%S) of each isolate in relation to all other isolates, the formula used was:

$$\%S = \frac{NS}{NS + ND} \times 100$$

where NS is the number of features in which the two organisms were alike and ND is the number of features in which they differed. The analysis of the data was carried out in the IBM 1620 and the programme followed was the one kindly furnished by Dr. Colwell. Each of the characters were punched on IBM code cards as 0 for negatipe, 1 for positve and 3 for not tested; 3 cards were punched for each strain and for all the 46 characters. Thus a total of 570 (510 for 170 new isolated strains and 60 for the 20 established strains) were punched, processed, and the data were got printed on IBM 704 machine and arranged in $t \times t$ table to form a triangular matrix.

The results presented in Table II are the %S values for only 36 representative strains selected from those analysed on the computer. It may be seen from the results that the strains within a group gave %S values between 95 and 100 showing a perfect matching with each other whereas those for individual pairs of strains for different groups were between 40 and 100% showing thereby the diversity among strains belonging to different groups. From the triangular matrix it is evident that the %S values between pair 1 and 9 is 62%, between 1 and 11 is 65%, and 1 and 24 is 68% and so on. Thus the symmetrical matrix provides a ready reference to obtain %S values of any pair of strains listed, besides offering the advantage that it can be used, as and when necessary, to accommodate new entries in appropriate groups.

The results presented here, when examined together with the *Arthrobacter* systematics worked out in this laboratory[17] on the basis of recommendations of the *Bergey's Manual*[18] as well as percentage occurrence of other characters of taxonomic importance, have led the authors to the conclusions that the genus *Arthrobacter* represents a homogeneous group and that Conn and Dimmick[19] were justified in bestowing the taxonomic status to the genus *Arthrobacter* albeit it was done for the convenience of segregating the saprophytic coryneform bacteria from those causing diseases of plants and animals.

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GENERALIZED MEAN-SQUARE AMPLITUDES OF VIBRATION AND SHRINKAGE EFFECT IN LINEAR AND PLANAR AXYZ TYPE OF MOLECULES

K. VENKATESWARLU AND MISS V. MALATHY DEVI

Department of Physics, Kerala University, Alwaye-2

SPECTROSCOPIC calculations of mean amplitudes of vibration and shrinkage effects are of great interest in modern electron diffraction studies on gas molecules. In the present investigation, the theory of mean-square amplitudes of vibration is applied to four molecules of the linear AXYZ type and two molecules of planar AXYZ and their generalized mean-square amplitudes of vibration, namely, parallel and perpendicular mean-square amplitudes and mean cross products at 300° K. are evaluated for all the bonded and non-bonded distance deviations.

The perpendicular mean-square amplitudes are determined by Morino's method.[1] The molecular parameters, frequencies, and kinetic energy matrix elements are taken from references (2) and (3). The parallel mean-square amplitude values for these molecules have been evaluated earlier.[4] The generalized mean-square amplitudes evaluated for linear and planar AXYZ molecules are reported in Tables I and II.

The deviation in the distance between two atoms from the sum of the distances between the atom pairs composing it is called the shrinkage effect. For linear AXYZ molecules, using the perpendicular mean-square amplitudes and by applying the theory developed by

TABLE I

Generalized mean-square amplitudes at 300° K. for linear AXYZ molecules (Å^2)

Bond	Mean-square amplitude	HN$_3$	DN$_3$	HNCO	HNCS
X–Y	$\langle(\triangle Z)^2\rangle$	0·001471	0·001478	0·001436	0·001412
	$\langle(\triangle X)^2\rangle$	0·003733	0·003135	0·003302	0·004549
	$\langle(\triangle Y)^2\rangle$	0·000777	0·000829	0·000917	0·001180
	$\langle(\triangle Z \triangle X)\rangle$	0·000312	−0·000253	−0·000031	−0·000032
Y–Z	$\langle(\triangle Z)^2\rangle$	0·001266	0·001272	0·001226	0·001586
	$\langle(\triangle X)^2\rangle$	0·004767	0·004590	0·003828	0·003435
	$\langle(\triangle Y)^2\rangle$	0·000825	0·000881	0·000887	0·000728
	$\langle(\triangle Z \triangle X)\rangle$	−0·003096	−0·000168	0·000003	0·000001
A–X	$\langle(\triangle Z)^2\rangle$	0·005526	0·004025	0·005503	0·005510
	$\langle(\triangle X)^2\rangle$	0·018194	0·012798	0·0228 8	0·027229
	$\langle(\triangle Y)^2\rangle$	0·000081	0·000087	0·000081	0·000125
	$\langle(\triangle Z \triangle X)\rangle$	−0·000587	−0·010353	−0·001104	−0·001499
X...Z	$\langle(\triangle Z)^2\rangle$	0·003048	0·003172	0·003164	0·003244
	$\langle(\triangle X)^2\rangle$	0·000161	0·000411	0·000202	0·000185
	$\langle(\triangle Y)^2\rangle$	0·000001	0·000001	0·000000	0·000542
	$\langle(\triangle Z \triangle X)\rangle$	−0·000174	−0·000150	−0·000033	−0·000057
A...Y	$\langle(\triangle Z)^2\rangle$	0·011190	0·009797	0·012170	0·012130
	$\langle(\triangle X)^2\rangle$	0·000061	0·004458	0·010456	0·013078
	$\langle(\triangle Y)^2\rangle$	0·000356	0·000380	0·000453	0·000537
	$\langle(\triangle Z \triangle X)\rangle$	−0·000681	−0·002563	−0·007808	−0·010446
A...Z	$\langle(\triangle Z)^2\rangle$	0·014750	0·013360	0·016650	0·017020
	$\langle(\triangle X)^2\rangle$	0·005771	0·005782	0·009330	0·011979
	$\langle(\triangle Y)^2\rangle$	0·000097	0·000104	0·000072	0·000014
	$\langle(\triangle Z \triangle X)\rangle$	−0·001126	0·000145	−0·004334	−0·006066

TABLE II

Generalized mean-square amplitudes $(Å^2)$ for HCOF and DCOF

Bond	Mean-square amplitude	HCOF	DCOF
X—Z	$\langle(\triangle Z)^2\rangle$	0·001954	0·00195
	$\langle(\triangle X)^2\rangle$	0·002689	0·003270
	$\langle(\triangle Y)^2\rangle$	0·000501	0·000840
	$\langle(\triangle Z\triangle X)\rangle$	0·002347	0·004117
X—Y	$\langle(\triangle Z)^2\rangle$	0·001310	0·001312
	$\langle(\triangle X)^2\rangle$	0·001311	0·001290
	$\langle(\triangle Y)^2\rangle$	0·000601	0·001007
	$\langle(\triangle Z\triangle X)\rangle$	−0·000247	0·00008
A—X	$\langle(\triangle Z)^2\rangle$	0·006304	0·004434
	$\langle(\triangle X)^2\rangle$	0·006881	0·007502
	$\langle(\triangle Y)^2\rangle$	0·010030	0·005965
	$\langle(\triangle Z\triangle X)\rangle$	0·000401	0·002622
A...Z	$\langle(\triangle Z)^2\rangle$	0·008002	0·006898
	$\langle(\triangle X)^2\rangle$	0·006925	0·008904
	$\langle(\triangle Y)^2\rangle$	0·006052	0·002327
	$\langle(\triangle Z\triangle X)\rangle$	−0·000175	−0·003043
A...Y	$\langle(\triangle Z)^2\rangle$	0·007649	0·006103
	$\langle(\triangle X)^2\rangle$	0·007572	0·013129
	$\langle(\triangle Y)^2\rangle$	0·005752	0·002070
	$\langle(\triangle Z\triangle X)\rangle$	0·000634	0·004725
Y...Z	$\langle(\triangle Z)^2\rangle$	0·004386	0·004365
	$\langle(\triangle X)^2\rangle$	0·000195	0·000544
	$\langle(\triangle Y)^2\rangle$	0·000004	0·000007
	$\langle(\triangle Z\triangle X)\rangle$	−0·000612	−0·001196

Morino, the shrinkages for the linear part are calculated and the values obtained are reported in Table III.

TABLE III

Bastiansen-Morino shrinkage effect in linear AXYZ molecules

Molecule	Bond	Shrinkage (Å)
HN_3	$N = N \equiv N$	0·004251
DN_3	$N = N \equiv N$	0·003923
HNCO	$N = C = O$	0·003718
HNCS	$N = C = S$	0·003558

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THE ROSE IN INDIA

TRACING briefly the place of rose in history, literature, myths, legends, art, music, poetry and heraldry, the author gives useful information on all aspects of growing roses—from soil requirements to showbench display and commercial manufacture of perfumes and rose products. The book contains a select enumeration of 506 rose varieties suitable for Indian conditions, arranged alphabetically, with notes on size, colour and fragrance of blooms, the height, habit, hardiness and resistance of plants and their individual behaviour.

The book is richly illustrated with eighty figures, more than half of them being represented in their natural and beautiful colours.

This is the first complete book of its kind written for rose lovers in the country. The author, B. P. Pal, a well-known rosarian and the President of the Rose Society of India, has devoted the major part of his spare time during the last 40 years to growing roses. He has also been breeding new rose varieties. In this book he condenses his lifetime observations and experience.

The Rose in India will be found to be of great interest and value by rose lovers and rose gardeners. Further, there is enough material in the book for professionals seeking to add to their knowledge, though it is essentially meant for the average reader and is therefore written in a simple and personal style.

LETTERS TO THE EDITOR

THE GRAVITATIONAL FIELD OF A CHARGED PARTICLE EMBEDDED IN AN EXPANDING UNIVERSE

THE gravitational field of an uncharged mass particle is described by the well-known Schwarzschild's exterior solution, while the corresponding field for a charged mass particle is described by Nordström's solution. In both these fields the space surrounding the particle is empty and the geometry at large distances from the particle reduces to flat geometry of special relativity.

McVittie[1] gave the line-element describing the gravitational field of an uncharged particle embedded in an expanding universe. The space round this mass particle is occupied by spherically symmetric distribution of matter with non-zero density and isotropic pressure which at large distances from the particle pass over smoothly to the cosmic density and pressure in homogeneous cosmological models. In what follows we report a line-element which describes the gravitational field of a charged particle in a homogeneous and isotropic cosmological model.

The line-element for this gravitational field is

$$dS^2 = \left(1 + \frac{m}{r} + G\right)^{-2} dt^2 - \left(1 + \frac{m}{r} + G\right)^2$$
$$\times (dr^2 + r^2 d\Omega^2) \qquad (A)$$

where $d\Omega^2 = d\theta^2 + \sin^2\theta d\phi^2$ and $G = G(t)$ is an undetermined function of t.

The space round this charged particle is filled with perfect fluid. There is also an electromagnetic field present round this charged particle. The energy-momentum tensor $T_j{}^i$ is of the form

$$T_j{}^i = (p + \rho) V^i V_j - p g_j{}^i - F^{ia} F_{jc}$$
$$+ \tfrac{1}{4} g_j{}^i F^{ab} F_{ab}$$

with $V^i = (0, 0, 0, V^4)$, $V_i V^i = 1$.

The pressure p and density ρ of the surrounding smoothed out universe are given by

$$8\pi p = -2\ddot{G}\left(1 + \frac{m}{r} + G\right) - 3\dot{G}^2$$

$$8\pi\rho = 3\dot{G}^2.$$

An overhead dot indicates differentiation with regard to t.

The electromagnetic field is described by the tensor F_{ik} whose only non-vanishing component F_{14} is given by

$$F_{14} = \frac{-m}{r^2 \left(1 + \frac{m}{r} + G\right)^2}.$$

This F_{ik} satisfies Maxwell's equations,

$$F_{jk}{}^{ik} = 0, \qquad \overset{*}{F}_{jk}{}^{ik} = 0$$

$*F^{ik}$ being the dual of F_{ik}.

In our line-element (A), the singularity occurs at $r = 0$. Therefore the charged particle is at rest at the origin.

Putting $G(t) = 0$ in (A), the present solution reduces to Bonner's[2] solution of a charged particle of charge e and mass m such that $e = -m$. On putting $m = 0$ in (A) one gets Einstein-deSitter's universe. Moreover, at large distances from the particle the electromagnetic field vanishes and the field merges into the homogeneous Einstein-deSitter universe.

The line-element (A) can be easily generalized so as to give the field of the charged particle in the general Robertson-Walker universe. The general form is

$$dS^2 = \left(1 + \frac{m}{r} \sqrt{1 - kr^2} + G\right)^{-2} dt^2$$
$$- \left(1 + \frac{m}{r} \sqrt{1 - kr^2} + G\right)^2$$
$$\times \left(\frac{dr^2}{1 - kr^2} + r^2 d\Omega^2\right) \qquad (B)$$

$$K = +1, -1 \text{ or } 0.$$

The above discussion arose from the study of the gravitational contraction of charged fluid spheres.

Dept. of Maths.,   P. C. VAIDYA.
Gujarat Univ.,   (MISS) YASHODHARA P. SHAH.
Ahmedabad-9,
November 25, 1966.

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X-RAY DETERMINATION OF THE THERMAL EXPANSION OF RHENIUM

RHENIUM, a metal crystallizing in the hexagonal lattice, has an axial ratio equal to 1·615 which is only slightly smaller than the value of the axial ratio (1·633) for an ideal hexagonal close-packed structure. This deviation from the ideal structure suggests that the metal should exhibit anisotropic physical behaviour, the anisotropy being small and such as would result from easier deformations of the lattice in the basal plane than those along the

hexagonal axis (Childs,[1] and Boas and Mackenzie).[2] Thus a_c, the principal coefficient of thermal expansion along the c-axis, would be expected to be smaller than a_a, the coefficient of expansion in any perpendicular direction. However, the only available report on the directional thermal expansion of rhenium published by Agte et al.[3] shows that the two principal coefficients of expansion are $a_c = 12 \cdot 45 \times 10^{-6}/°$ C. and $a_a = 4 \cdot 67 \times 10^{-6}/°$ C. These results show not only a high degree of anisotropy in thermal expansion but, what is more, give an anisotropy of a nature ($a_c > a_a$) opposite to the one expected from the lattice structure. This lack of conformity between the structure and the experimental results and also the non-availability of systematic data on the temperature variation of the lattice parameters led the authors to undertake a fresh experimental investigation of the problem.

Specpure sample of rhenium, annealed for six hours at 1200° C., was used for preparing powder specimen for X-ray diffraction work. Using an experimental technique described earlier,[4] powder pictures were obtained at different temperatures. Five sharp $a_1 a_2$ reflections from (21·1), (11·4), (10·5), (20·4) and (30·0) planes, recorded in the back-reflection region, were used in evaluating the lattice parameters by the procedure given by Deshpande and Pawar.[4]

In Table I, the values of the lattice parameters obtained at different temperatures along with the standard errors in their room temperature values, calculated by the method of Jette and Foote,[5] are given.

TABLE I
Lattice constants of rhenium at different temperatures

Temperature ° C.	'a' Å	'c' Å
25	2·7606±0·0001	4·4578±0·0002
16J	2·7634	4·4613
258	2·7650	4·4633
354	2·7877	4·4648

Since the temperature variation of both the parameters, within the range of experimental errors, was found to be linear, the coefficients of expansion were obtained from the slopes of the parameter *versus* temperature graphs. The values of the two principal coefficients were found to be $a_c = 4 \cdot 8 \times 10^{-6}/°$ C. and $a_a = 7 \cdot 9 \times 10^{-6}/°$ C.

The present values are thus found to be in good accord with the requirements of the structure of the metal. Support for the correctness of the present results is obtained

from the values of the linear compressibilities of the metal along and perpendicular to the c-axis, calculated from the recently published data on elastic constants of rhenium.[6] These compressibilities, evaluated by the method given by Boas and Mackenzie,[2] come out as

$$K_c = 0 \cdot 909 \times 10^{-13} cm.^2/dyne$$

and

$$K_a = 0 \cdot 921 \times 10^{-13} cm.^2/dyne.$$

It follows from these values that the binding between neighbouring atoms in the basal plane of the lattice is weaker than that along the c-axis and so the coefficient of expansion along the a-axis ought to be larger than that along the c-axis. This is what the present investigation has shown to be true. The results given by Agte et al.[3] thus appear to be incorrect. However, the coefficients of volume expansion calculated from the present values and also those from Agte et al. are found to be in agreement with each other and also with the value given by Sims et al.[7] These values are $20 \cdot 6 \times 10^{-6}/°$ C., $21 \cdot 79 \times 10^{-6}/°$ C. and $19 \cdot 8 \times 10^{-6}/°$ C. respectively.

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Department of Physics,   RAM RAO PAWAR.
Univ. College of Science,   V. T. DESHPANDE.
Osmania University,
Hyderabad-7, *December, 21, 1966.*

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CO-ORDINATION COMPLEXES OF MOLYBDENUM (V) CHLORIDE ALKOXIDES WITH DIPYRIDYL*

SIMPLE and polymeric dipyridyl complexes of niobium and tantalum oxy-chloride alkoxides have been reported[1] and these were prepared by the interaction of their chlorides with dipyridyl in aqueous alcohol. The present investigation deals with the preparation of dipyridyl derivatives of molybdenum (V) chloride alkoxides in anhydrous alcohols. Molybdenum pentachloride has already been

found to react with primary and secondary alcohols forming chloride alkoxides[2] of the general formula $MoCl_3(OR)_2$, where R = alkyl group. It has now been observed that the above chloride alkoxides form co-ordination complexes with dipyridyl having the general formula $MoCl_3(OR)_2$. dipy (dipy = dipridyl) and even when a large excess of dipyridyl is used, not more than one molecule of it is attached to the chloride alkoxide. The above complexes have been readily obtained both by the direct interaction of the chloride alkoxide with dipyridyl in alcohol medium and by the alcohol interchange method.[2] The dipyridyl complexes of molybdenum trichloride diethoxide and di *n*-butoxide can be heated to 160° C. and 170° C. respectively without undergoing any sublimation and are recovered unchanged, whereas the simple chloride alkoxides of Mo (V) decompose at a much lower temperature.[2] These results indicate that the dipyridyl derivatives are more stable than the parent substances. The molecular weights of the above co-ordination complexes could not be readily determined on account of their insolubility in alcohols and benzene.

Preparation of Molybdenum Trichloride Di-Alkoxides

These were prepared by refluxing pure molybdenum pentachloride with appropriate alcohol in the presence of benzene for 3 hours.[2]

Preparation of Molybdenum Trichloride Di-Alkoxide Complexes with Dipyridyl

(a) *Direct Method.*—To molybdenum trichloride diethoxide (5 g.) in ethyl alcohol (50 g.), was added dipyridyl (2·67 g.) in ethyl alcohol (50 g.). On refluxing the mixture for two hours, a reddish-brown precipitate was obtained. The supernatant liquid was decanted off and the composition of the solid residue after it was dried under reduced pressure could be represented by the formula $MoCl_3(OEt)_2$.dipy. (Found: Mo, 21·11; Cl, 23·20; OEt, 19·82; N, 5·92; Calc. for $MoCl_3(OEt)_2$.dipy: Mo, 21·40; Cl, 23·70; OEt, 20·0; N, 6·2%). The data concerning the preparation of other complexes are given in Table I. Satisfactory analysis was obtained for all these complexes.

(b) *Alcohol Interchange Method.*—A suspension of dipyridyl complex of molybdenum trichloride diethoxide (3·05 g.) in a mixture of isopropyl alcohol (40 g.) and benzene (100 g.) was refluxed and later fractionally distilled. The ethyl alcohol liberated in the reaction was removed as benzene-alcohol azeotrope. The solution was then evaporated to dryness under

reduced pressure and dipyridyl complex of molybdenum trichloride di-isopropoxide (3·08 g.) was obtained as a brown solid. (Found: Mo, 20·0; Cl, 22·03; OPr, 24·45; N, 5·79; Calc. for $MoCl_3(OPr)_2$.dipy: Mo, 20·14; Cl, 22·35; OPr, 24·76; N, 5·87%). The data concerning the preparation of various complexes are given in Table II. Only in the case of methoxy dipyridyl complex the fractionation procedure was omitted and the mixture of methyl and ethyl alcohols was removed by evaporation under reduced pressure and the product repeatedly treated with fresh methyl alcohol until interchange was complete.

TABLE I

Dipyridyl complexes of molybdenum chloride alkoxides prepared by direct method

Alkyl group present in the dipyridyl complex of molybdenum chloride alk-oxide $MoCl_3(OR)_2$.dipy.	1 $MoCl_3(OR)_2$ Amount taken (g.)	2 Dipyridyl Amount added (g.)	Total amount of alcohol added to 1 and 2 (g.)	$MoCl_3(OR)_2$.dipy. Amount of the complex isolated (g.)
Me ..	2·50	1·48	100	3·85
Pr^n ..	2·45	1·20	125	3·54
Pr^i ..	3·52	1·72	125	5·05
Bu^n ..	3·55	1·59	150	5·00
Bu^i ..	2·56	1·15	150	3·65
Bu^t ..	2·65	1·19	150	3·60
n-amyl ..	2·22	0·92	150	3·00

TABLE II

Dipyridyl complexes of molybdenum chloride alkoxides prepared by alcohol interchange method

Alkyl group present in the dipyridyl complex of molybdenum chloride alk-oxide $MoCl_3(OR)_2$.dipy	$MoCl_3(OEt)_2$.dipy Amount taken (g.)	Amount of alcohol added (g.)	Amount of benzene added (g.)	$MoCl_3(OR)_2$.dipy. Amount of the complex isolated (g.)
Me ..	2·00	70	..	1·85
Pr^n ..	2·55	30	80	2·69
Pr^i ..	3·05	40	100	3·08
Bu^n ..	2·45	30	100	2·70
Bu^i ..	2·60	35	100	2·80
Bu^t ..	1·50	30	80	1·62

Analysis.—Molybdenum and chloride were analysed as oxinate and silver chloride respectively. Methoxide, ethoxide and isopropoxide were analysed by the chromic acid method.[3,4] The absorption at 1600 cm.⁻¹ in the IR spectra

of dipyridyl derivatives of molybdenum trichloride diethoxide and di-isopropoxide indicate the formation of these co-ordination complexes.

DISCUSSION

The formation of co-ordination complexes of metal alkoxides has been observed in a few cases only,[5] whereas the chloride alkoxides of metals readily form such complex compounds with alcohols,[5] esters,[5] ammonia[6] and amines.[6] The present investigation shows that molybdenum chloride alkoxides also form co-ordination complexes with dipyridyl, thereby illustrating the enhanced tendency of a metal alkoxide to form co-ordination complexes when an electronegative group is already attached to the metal.

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Department of Chemistry,   S. K. ANAND.
University of Delhi,   B. D. JAIN.
Delhi, *January* 9, 1967.   R. K. MULTANI.

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PREPARATION OF IODINE-131 LABELLED POLYVINYL PYRROLIDONE (PVP)

POLYVINYL pyrrolidone (PVP) labelled with iodine-131 appears to be of use in medicine for studies of protein disorder.[1,2] Iodine-131 (PVP) has been prepared[2] by the Sandmeyer reaction on *p*-toluidine polyvinyl pyrrolidone. An alternative method of labelling PVP, which appears to be simpler, has been developed here, based on labelling with active iodine liberated during the electrolysis of sodium iodide-I-131. A method has also been developed based on column chromatography over DEAE Sephadex A-25 to ascertain the radiochemical purity of the labelled PVP.

500 mg. of polyvinyl pyrrolidone (L. Light and Co., Mol. wt.—24,500—biologically tested) was dissolved in 25 ml. of water, and the solution dialysed against repeated changes of double distilled water for 24 hours, to remove any lower molecular weight fractions or impurities, and then aseptically filtered.

(*a*) 5 ml. of the dialysed PVP solution was adjusted to pH 6-8 using dilute NaOH and about 1 mc. of NaI-131 (100–200 mc./ml., pH 8, sulphite, thiosulphate and carrier-free, reducing agent content less than 5×10^{-5} mM per millilitre) was added. The mixture was electrolysed at 0·2–2 m. amps. current using platinum electrodes and with stirring (1–10 volts) for 1 to 6 hours. The experiments were repeated after adding 1–10 μg. of iodide carrier. In all cases, the labelled mixture was dialysed overnight against repeated changes of water, to remove unbound iodine and the radiochemical recovery estimated (Table I).

TABLE I

Sl. No.	Time of electrolysis (hours)	Total I″ carrier added μg.	Current m.amps.	Percentage recovery %	pH of the PVP-I″ mixture
1	1	..	0·2	10	6
2	2	..	0·2	15	6
3	3	..	0·2	20	8
4	6	..	0·2	25	6
5	2	5	0·2	10	8
6	3	10	2	20	6
7	6	10	2	25	6
8	6	10	2	25	8

(*b*) The electrolysis was repeated using NaI-131 solution (pH 8–9) containing known quantities of the following reducing agents: sulphite, thiosulphate, oxalate, and cysteine. It was found that cysteine inhibited the labelling completely, while increasing concentrations of the other reducing agents (0·01-mM) decreased the labelling yield.

(*c*) NaI-131 solution (1 millicurie in 10 ml. carrier and reducing agents free) was adjusted to pH 6-8 and electrolysed for 1–6 hours at 0·2–2 m. amps. current (1–100 volts). The solution was analysed from time to time by paper chromatography, using 70% aqueous methanol as solvent. The experiment was repeated after adding 1–10 μg. of iodide carrier also (Table II). It was found that high specific iodine-131 activity was oxidised to iodate under these conditions.

The experiment was repeated after adding 0·01 to 1 millimole of sulphite or oxalate or thiosulphate or cysteine hydrochloride to the NaI-131 solution. It was found that the oxidation of iodine to iodate was completely inhibited by the presence of cysteine hydrochloride while the other reducing agents interfered only in high concentrations (Table II).

(*d*) The pure labelled PVP I-131 was adjusted to pH 5-8, using glycine buffers (M. Glycine + 1 M HCl or 1 M NaOH) and kept for 1 to 4 days at 2-10° C. in a refrigerator. Aliquots of the product were analysed for unbound iodide

TABLE II
Electrolysis of NaI-131 solution

Sl. No.	pH of the NaI-131 solution	Current m.amps.	Carried added	Reducing agent added and quantity	% of iodate produced	Time of electrolysis
1	6	0·2	..	Sulphate, oxalate $<5\times10^{-6}$ mM	30	1
2	6	0·2	..	..	60	2
3	6	0·2	..	..	88	3
4	8	0·2	..	..	45	1→ Iodine
5	8	0·2	..	..	80	2 is libera-
6	6	2	..	..	60	1 ted dur-
7	6	0·2	..	Cysteine 1 mM	< 5	1 ing elec- trolysis
8	8	0·2	..	Sulphite or Thio- sulphate 1 mM	<10	1
9	8	2	..	Cysteine 1 mM	<10	1
10	6	2	..	Sulphate or oxalate 1 mM	25	2

by anion-exchange separation, using a column of Dowex-1 Cl⁻, washed with the buffer. It was found that product remained pure for a period of 14 days at pH 5–6.

(*e*) The radiochemical purity of the labelled PVP was studied by using a column of DEAE Sephadex A-25 (Pharmacia, Uppsala—Sweden). The pure PVP-I[131] was adsorbed on the Sephadex column along with iodide-I[131] from very dilute NaCl or phosphate solution (0·1 molar). On elution with sodium chloride solution 0·1–1 molar the iodine-131 PVP was quantitatively eluted out as a single fraction (with 0·5 M NaCl) followed by unbound iodide.[4]

The labelling of PVP during the electrolysis of NaI-131 solution takes place by the active iodine produced during the electrolysis. The iodine also undergoes oxidation during the electrolysis to produce iodate. Both the label-ling and oxidation processes are inhibited by the presence of reducing agents in the I-131 solution. PVP does not appear to undergo any damage during the labelling.

Isotope Division,　　　　　　　　R. S. MANI.
Atomic Energy Establishment,
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CHEMICAL INVESTIGATION OF THE SEEDS OF *CLITORIA TERNATEA* 'LINN.'

THE plant *Clitoria ternatea* 'Linn.' (Family-Leguminosæ) grows widely in various parts of India. Its bitter roots are used as a cathartic, purgative and diuretic while the seeds are stated to possess purgative and aperient activity.[1] The seeds are reported to contain a bitter, crystalline ester ($C_{15}H_{24}O_6$) and an amorphous glucoside of a steroidal lactone.[2]

It was considered of interest to undertake a detailed chemical investigation of the seeds. The defatted seed powder was extracted with 70-90% aqueous alcohol and concentrated extract was treated with lead acetate for precipitation of the tannin material. The clear filtrate was concentrated and extracted with chloroform, chloroform-*n*-butanol (7 : 3) and *n*-butanol.

Attempts to resolve the chloroform and chloroform-*n*-butanol extracts on paper or on T.L.C. were not successful but the *n*-butanol extract revealed thirteen distinct spots in T.L.C. on Kieselgel G [system : ethyl acetate-ethanol-water (6 : 2 : 2) using 1% ceric sulphate in $2N-H_2SO_4$ as spraying reagent]. These were provisionally named as substances A, B, C, D, E, F, G, H, I, J, K, L and M with R_f values 0·85, 0·77, 0·70, 0·64, 0·60, 0·55, 0·50, 0·47, 0·44, 0·41, 0·33, 0·21 and 0·10 respectively.

A primary fractionation of the *n*-butanol extract was effected by partition chromato-graphy on a silica gel column,[3] using water saturated ethyl acetate as the eluant; simpler fractions containing mixtures of two to four components only were obtained. Some of these fractions yielded chromatographically pure substances by repeated adsorption and partition chromatography over silica gel. Thus six crystalline compounds, *viz.*, A, B, G, I, J and M were obtained. Their properties are listed in Table I.

A preliminary chemical examination of the isolated compounds led to the classification of substance-A as an unsaturated phenolic acid, substances B, G. and J as glycosides,[4] and substance-M as a polypeptide.[5]

Substance-A was identified as *p*-hydroxy cinnamic acid, being identical in m.p. and m.m.p. with an authentic sample. Confirmation was provided by thin layer co-chromatography and preparation of the acetate.

Substance-B on acid hydrolysis yielded a phenolic aglycone and two sugars, identified by paper chromatography as glucose and fructose.

TABLE I

Properties of the isolated substances

Substances	Solvent* of crystallisation	m.p. °C.	Specific rotation*	Calculated			Found			λmax. mμ log E (in alcohol)
				%C	%H	%N	%C	%H	%N	
Substance-A ($C_9H_8O_3$)	Me	212–14	+ 0.6 (Me)	65.83	4.91	..	65.58	4.92	..	290 (4.26)
Substance-A acetate ($C_{11}H_{10}O_4$)	Alc	206– 8	– 0.5 (Me)	64.09	4.85	..	63.99	5.09	..	270 (4.40)
Substance-B ($C_{43}H_{48}O_{20}$)	Me	218–20	–181.00 (Me)	58.34	5.46	..	58.06	5.52	..	..
Aglycone of B ($C_{31}H_{28}O_{10}$)	AcOEt.	250–51	..	66.40	5.03	..	C6.40	4.74	..	..
Substance-G ($C_{29}H_{40}O_{20}$)	W	201	– 61.3 (Me)	49.16	5.69	..	49.06	5.50	..	266 (4.15) 347 (4.08)
Aglycone of G ($C_{17}H_{14}O_8$)	Aq.alc	275 (subl.)	..	58.95	4.07	..	58.84	3.98	..	266 (4.28) 367 (4.35)
Substance-I ($C_{27}H_{23}O_{11}N_{13}$)	Alc	235	..	45.32	4.65	25.40	45.51	4.75	25.48	..
Substance-J ($C_8H_{16}O_6$)	Alc	140	+172 (Me)	46.15	7.74	..	45.82	7.73	..	..
Substance-J acetate ($C_{16}H_{24}O_{10}$)	n-Pn	87–88	+135 (Me)	51.05	6.42	..	51.16	6.46	..	..
Substance-M ($C_{42}H_{62}O_{16}N_8$)	Alc	210	– 82 (Py)	53.95	6.68	11.98	54.23	6.46	12.23	..

* Me=Methanol, Alc=Alcohol, W=Water, *n*-Pn – *n*-Pentane Py=Pyridine, AcOEt=Ethyl acetate.

Substance-G on acid hydrolysis gave a yellow, crystalline aglycone, which was considered to be a flavonol on the basis of its colour reactions with Mg-HCl, NH_3, $AlCl_3$ and its UV spectra in ethanol and in 0.002 N sodium ethoxide solution.[6] The long wavelength band shown by the aglycone in ethanolic solution disappeared in alkaline medium while in case of substance-G, this band showed a bathochromic shift of 53 mμ on addition of alkali, thus indicating that substance-G was a flavonol-3-glycoside. The sugars were identified as glucose and rhamnose by paper chromatography.

Substance-J was identical with ethyl-α-D-galactopyranoside[7] in m.p. and specific rotation and its acetate also agreed in m.p. and specific rotation with the values reported in literature for the tetraacetate of ethyl-α-D-galactopyranoside.[8]

Substance-M on acid hydrolysis revealed six amino-acids on paper chromatogram. Three of these were identified as proline, valine and tyrosine.

The exact nature of the nitrogenous substance-I could not be ascertained. It did not give a positive test for alkaloids and its colouration with ninhydrin was very feeble. Though it gave a positive Feigel test[4] indicating the possible presence of a carbohydrate moiety in the molecule, it decomposed when subjected to acid hydrolysis.

Chemistry Dept.,   D. K. KULSHRESHTHA.
Lucknow University,   M. P. KHARE.
Lucknow, *August* 24, 1966.

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RICH SOURCES OF SOLASODINE

WE have earlier reported[1] a rich source of solasodine from berries of *Solanum khasianum.* Herein two other good sources are reported. These are berries of *S. auriculatum* and *S. elæagnifolium.*

4·5 kg. of air-dried powdered berries of *Solanum auriculatum* was extracted first with petroleum ether and then with alcohol. The alcohol-free extract weighed 1,180 g. 300 g. of this was taken, washed repeatedly with ether when the ether-insoluble portion became granular. The ether washing on working up gave 0·58 g. of alkaloid which crystallised from alcohol in fine needles, m.p. 198°. It gave pink colour with resorcinol-acetic-sulphuric acid and yellow colour with tetra-nitromethane. It was found to be solasodine both from mixed m.p. and T.L.C. The ether-insoluble solid was dissolved in water and basified with ammonia. A flocculent precipitate separated which was filtered and dried (72 g.). This was decolorised with charcoal and next hydrolysed with 5% alcoholic hydrochloric acid. The alcohol was removed with addition of water on water-bath. The entire mass was made alkaline with ammonia while hot when 23·04 g. of a base separated. This was found to be solasodine from its colour reactions, mixed m.p. and T.L.C. The overall yield of solasodine from this source amounts to 2·07% on dry weight of the berries.

1·4 kg. of air-dried powdered berries of *Solanum elæagnifolium* was first defatted with petroleum ether and then extracted with alcohol. The alcohol extract was not concentrated but mixed with one-fifth of its own volume of concentrated hydrochloric acid and hydrolysed under reflux for six hours. The bulk of solid which separated on distilling out the alcohol with addition of water was filtered. The filtrate contained very little alkaloid and was rejected. The entire dry solid (86 g.) was extracted with benzene in a Soxhlet. The solid left in the Soxhlet after benzene extraction was decolorised with charcoal. The pale yellow hydrochloride was suspended in water, boiled and basified with ammonia while hot. The precipitated alkaloid weighed 44·6 g. This was found to be solasodine both from colour reactions and comparison with an authentic sample. The yield amounts to 3·2% on the dry weight of the berries.

Of the three good sources of solasodine, namely, *S. khasianum* (5%), *S. elæagnifolium*

(3%) and *S. auriculatum* (2%) come across during a study of 28 species of *Solanum,* available in India, *S. elæagnifolium* holds out to be an ideal plant to be raised as a potential drug crop since this plant is thornless and collection of berries from this plant is much easier than from *S. khasianum* which is heavily prickled although richer in its solasodine content.

Central Forensic Science   P. C. MAITI.
                Laboratory,
30, Gora Chand Road, Calcutta,
            and
Botanical Survey of   REBECCA MATHEW.
        India,
76, Acharya J. C. Bose Road,
Calcutta, *September* 19, 1966.

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A NEW SOURCE OF MANNITOL

d-MANNITOL has varied applications in the laboratory, industry and in medicine. Its aqueous solution is employed for performing renal function test and as an irrigating fluid in prostatic surgery. Its hexanitrate acts as a vasodilator and is a useful remedy for cases of coronary insufficiency. It is used as an excipient and diluent in pharmacy and for Boron determinations in analytical laboratory. In industry, it is used in the manufacture of artificial resins, plasticisers, and dry electrolytic condensers for radio applications.

The chief natural source of mannitol is manna—a type of exudate from plants of species *Fraxinus ornus* L., *Oleaceæ*, etc., found in countries of the Mediterranean basin, Asia Minor and Spain, and *Alghai maurorum* medic. and *Pseudotsuga douglasii* (the Douglas fir tree) of Indian origin. The yield ranges from 10 to 55% depending upon the origin of manna. It has also been detected in small amounts in the tubers and roots of many other plants. We report here, for the first time, isolation of *d*-mannitol in more than 10% yield from the root bark of *Clerodendron serratum* Spreng., found more or less throughout India.

One hundred g. of the powdered plant material was soxheleted with 95% ethanol for several hours. Much crystalline material separated even while the extraction was going

on. On cooling the extract, a thick crop of crystalline needles resulted which were separated by filtration under suction and recrystallised thrice from 95% ethanol after treatment with active charcoal. Yield, 10·9%, m.p. 166° (corr.), *Anal.** :—Found : C, 39·67 ; H, 7·67. Calculated for $C_6H_{14}O_6$ (mannitol): C, 39·56 ; H, 7·74. The details of chemical and chromatographic identification procedures will be published elsewhere.

Pharmacology Department,   S. C. L. VERMA.
Gandhi Medical College,   V. P. GARG.
Bhopal, *September* 26, 1966.   S. S. GUPTA.

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* Through the courtesy of Dr. Sukh Dev, National Chemical Laboratory, Poona.

A NOTE ON THE FIND OF GYPSEOUS CLAYS AT RED HILLS, NEAR MADRAS CITY

IN a boring put down by a private party for water 0·4 km. south-east of Muttiripalaiyam village (12° 10′ 45″: 80° 09′ 66″ C/4) on the western side of the Red Hills lake, about 16 km. north-west of Madras City, the following lithological log was prepared by examining the material brought out by hand-drilling and in consultation with the Driller for the depths.

In metres	In feet	
0·00– 0·60	0–2	Ferruginous gravel
0·60– 2·74	2–9	White shales
2·74–18·28	9–60	Mottled clay
18·28–27·43	60–90	Yellow and mottled clay
27·43–32·58	90–107	Black (carbonaceous) clay with gypsum

The top 27·43 m. (90 ft.) of the material was identified as of Cuddalore age (Mio-Pliocene). The Cuddalore sandstones are regarded as of freshwater origin. The presence of gypsum in the black (carbonaceous) clay below 27·43 m. (90 ft.) suggests that it is perhaps part of a marine sequence of sediments underlying the Cuddalores. The correlation of this black gypseous clay horizon below the Cuddalores with the Eocene succession, which is unknown in this region, is being further studied.

Madras-4,   MOHAMMAD AHMAD.
September 16, 1966.

ACTIVITIES OF LACTIC DEHYDROGENASE AND CYTOCHROME OXIDASE IN RELATION TO THE CHARGE DENSITY IN THE AMPHIBIAN PECTORALIS MUSCLE

THE components of living cells were found to possess electrical charges either a net positive sign of the charge or a net negative sign of the charge.[1-7] Whole cells are normally found to exhibit a net negative sign of the charge and in some cases the pattern of orientation in an electric field is dependent on the charge distribution on the outer surface.[8]

A possible relation between charges on the enzyme molecules as well as the protein environment and the expression of the enzyme activity was suggested.[1-4,11,12] In the present study an attempt was made to investigate such relationship in the pectoralis muscle since the fibres run end to end.

Material and Methods: Preparation of the material.—*Rana hexadactyla* were double pithed and the pectoralis muscles from both the legs were isolated with least injury. The muscles were washed in amphibian Ringers medium[9] for 5 times to wash off the clot and injury substances and allowed to stand in Ringers medium for 10 minutes to recover from shock effects. Out of the two muscles isolated from one frog, one was used as control and the other, namely the experimental, was exposed to a direct current of 6 volts D.C./cm. along the long axis for 10 minutes. At the end of the experiment the muscle was cut transversely in the middle into two halves. The half which was at the proximity of the cathode pole was called as the cathode half and the other the anode half.

Cytochrome Oxidase Activity.—The enzyme activity was estimated by the "New colorimetric method"[10] in the control and the experimental muscle halves. This method was slightly modified owing to the low amount of cytochrome oxidase content present in the skeletal muscles, as follows : 0·3 ml. of 0·2 M p-phenylenediamine and 0·3 ml. of 0·2% neotetrazolium chloride were mixed and 0·3 ml. of 20% tissue homogenate prepared in 0·1 M phosphate buffer at pH 7·6 and 0·3 ml. of 10^{-4} M cytochrome C was added. For the substrate control, *i.e.,* endogenous enzymes, 0·3 ml. of distilled water was used in the place of *p*-phenylenediamine. For enzyme control, 0·3 ml. of 0·1 M phosphate buffer at pH 7·6 was used in place of the tissue homogenate.

Lactic Dehydrogenase.—The activity was estimated in the control and the experimental

muscle halves by modified method of triphenyltetrazolium chloride test.[11]

Results and Discussion.—The lactic dehydrogenase activity was found to be 4333 ± 1581, 3137 ± 1132 and 2883 ± 1154 μg. per gram wet weight in the control, cathode and anode half muscle homogenates respectively. The activity was found to be less in the experimental muscle halves than in the control. Between the experimental muscle halves, the value was higher in the cathode half than in the anode half indicating the migration of the enzyme towards the cathode suggesting the existence of a net positive sign of the charge on the enzyme molecule. Activity per milligram of protein indicated an increase in the anode half and a decrease in the cathode half. Since it was found that the cathode and the anode half accumulate protein fractions having a net positive and the negative sign of the charges,[1-4] it is likely that the density of charges could be responsible for the alteration of activity in the experimental muscle halves.

The cytochrome oxidase activity was found to be $287 \pm 58 \cdot 51$, $240 \pm 68 \cdot 7$ and $154 \cdot 27 \pm 76 \cdot 49$ μg. per gram wet weight in the control, cathode and anode half muscle homogenates respectively. The activity decreased in the experimental muscle halves as was found in the case of lactic dehydrogenase. Between the experimental muscle halves, the activity was greater in the cathode half than in the anode half indicating the net positive sign of the charge on the enzyme molecule. Estimation of activity per mg. protein indicated an activation of the enzyme by positively charged protein environment.

TABLE I

Lactic dehydrogenase (I) and Cytochrome oxidase (II), estimated by the modified method of Govindappa et al. (1966) and Takuzo et al. (1958)

Muscle	(I)		(II)	
	A	B	C	D
Control ..	4333±1581	57·73	280·0 ±58·57	3·823
Anode half	2883±1581	55·09	154·27±76·49	1·898
Cathode half	3137±1132	38·60	240·0 ±68·1	4·598

A = μg. of formazon/g. wet weight of the muscle.

B = Activity of the enzyme expressed in terms of formazon/mg. wet weight of the muscle.

C = μg. of NTC reduce/g./hr.

D = Activity of enzyme expressed in terms of NTC reduced/mg. of protein.

Since lactic dehydrogenase and cytochrome oxidase were known to mark the localization of soluble protein and mitochondria[16-18]

respectively it is possible that these cell components are having a net positive sign of the charge in the living cells, consequently showing cathodal migrations.

Dept. of Zoology,   Y. SURENDRANATH REDDY.
S.V.U. College,
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GAMETES AND GERMLINGS OF *ULVA FASCIATA* DELILE

THE green seaweed *Ulva fasciata* grows commonly on the Jalleshwar Reef, Veraval (Saurashtra), on the margins of pools situated in the intertidal region and attains the maximum length of 1–2 m. during October-December. However, full growth is not necessary for swarmer formation as this has been observed frequently in earlier months. The plants shed swarmers during exposure in the mornings in very large numbers and these impart a yellow-green colour to the surrounding sea-water. A fortnightly rhythm in their formation associated with spring tides was also noted. A study of swarmer output and the early growth of germlings was undertaken.

A small plant (16·9 cm. long) with one prominent blade was chosen and six fragments were removed. Each fragment was placed over a slide immersed in sea-water in a pertri dish. The fragments, marked serially, were placed under constant temperature (22° C.) and light (800 lux) conditions. Entire fragments taken from the apical portion and in the other fragments, the part corresponding to the margins

of the thallus showed change in pigmentation from green to yellow-green an hour prior to the division of the cells. The formation and liberation of the swarmers form the yellow-green part of the thallus took three hours.

The swarmer output in the shedding was estimated by measuring the area of the blade over which swarmer formation took place, and from this the approximate number of reproductive cells determined. The number of swarmers formed per cell was determined by direct microscopic counting. The swarmer output was computed from these data and this numbered 11,534,400 in the plant observed. The swarmer formation took place at fortnightly intervals, and in course of time the entire thallus formed swarmers. The above estimate is, however, for the first shedding only.

The swarmers which were estimated in this instance proved to be gametes. The gametes were ovoid with tapering anterior end which may sometimes be slightly drawn out (Figs. 1, 5, 6, 10), from which two flagella of equal

Figs. 1-6 ⸺ 5 ⎧

Figs. 7-10 ⸺ 10 ⎧

FIGS. 1-10

size arose. The gametes were of unequal sizes and measured $6 \cdot 4$-$9 \cdot 6\,\mu$ long and $3 \cdot 2$-$6 \cdot 4\,\mu$ broad. Gametes of different sizes usually met by their anterior ends and fusion occurred either anteriorly or laterally (Figs. 2-4, 7-9). The flagella were retained for some time, but were usually shed before fusion of the gametes completed. Although anisogany has been reported in *Ulva* Spp.,[1-6] the report for *Ulva fasciata* appears to be the first.

The germlings were kept growing attached or in a free-floating condition in the petri dishes in sterile sea-water which was changed once a week. In two months the germlings differentiated into cylindrical plants with 2-3 branches arising from the basal cells. The

floating plants were longer $1 \cdot 25$ to $1 \cdot 75$ mm. and produced branches, while the attached ones were shorter $0 \cdot 75$ to $0 \cdot 83$ mm. and unbranched. The growth of germlings did not advance beyond the cylindrical form during these two months as has been observed by other workers.[7,8]

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Central Salt and Marine   K. Subbaramaiah.
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    Institute,   V. Krishnamurthy.
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TWO INTERESTING CASES OF SPAWNING OF MAJOR CARPS IN CONFINED CEMENT TANKS

Pituitary induction of spawning of major carps in confined waters has become a widespread practice.[1] Prior to the perfection of this technique, obtaining of seed of major carps species was left to the vagaries of nature. In Madras State, the Freshwater Biological Station initiated experimental work on induced spawning of major carps in a few centres. During July-August 1966, instances of fish spawning without pituitary injections were noted by us. On 9th July in a circular ornamental cement tank of 8 m. diameter, two *happas* were fixed, one each with pairs of male and female *Labeo rohita*. Three pairs of *Cirrhina mrigala* were confined outside the *happa*. Of these, *L. rohita* pairs were injected with extract of alcohol preserved gravid-fish pituitary. These were mixed collection of glands from gravid females and males. The *mrigals* in the cement cistern were uninjected. Overnight, the *L. rohita* in one happa had spawned and *C. mrigala* which were not treated but were in the cement pond adjacent to the *happa* had also spawned. This unexpected spawning of the control fish is the first instance of a major carp spawning in confinement without pituitary induction. We repeated the experiments on ten more occasions and the data are summarized in Table I. On days when spawning by injected pair was not successful

Letters to the Editor

(all eggs turned to be non-viable), the uninjected pairs also failed to spawn. In every case where injected fish indulged in sexual play and spawned, the uninjected pair in the cement cistern also spawned and the hatchlings from these have been transplanted to nurseries in Vaigai Dam, Poondi Reservoir and Bhavanisagar.

The mechanism of successful spawning of the uninjected pair of major carp species needs study. Aronson[2] thinks that "simultaneous spawnings add to the confusion and turmoil, all of which seems to have high stimulative value". He also cites other authors to prove that chemicals produced by the ovaries of gravid female stimulates courtship. It is possible that certain 'ectocrines' excreted by the gravid pituitary injected fish while spawning, stimulate the uninjected fish to spawn. These latter seem to be more successful in spawning than the injected ones. Hoar[3] thinks that the materials which can penetrate gill membranes reach the pituitary readily. Whatever the mechanism, these observations throw open vast possibilities in fish cultural practices. The range of chemical conditions of the water of the cement tank are furnished in Table II.

Another interesting observation was that human pregnancy urine injected to fishes induced them to spawn and produce healthy

TABLE I
Details of experiments in which uninjected fish spawned

Expt. No.	Date	Number of pairs and *happas* Injected (pituitary)	Uninjected	Successful spawning and fertilization Injected	Uninjected	Number of hatchlings Injected	Uninjected	Remarks
1	9-7-1966	*L. rohita* 2 *C. mrigala* 1	*C. mrigala* 3	2 pairs (1 mrigala 1 rohita)	1 pair	75,000	1,000	Observed the successful spawning of this pair only on 10-7-1966 and was at that time considered unnatural so hatchlings died for want of care
2	12-7-1966	*C. mrigala* 4	. 3	3 pairs	1 pair (from 3 pairs)	450,000	200,000	..
3	13-7-1966	,, 2	.. 1	Nil	Nil	Nil	Nil	..
4	20-7-1966	*C. mrigala* 5 *L. rohita* 1	., 2	4 pairs (mrigala)	2 pairs	575,000	325,000	Poor yield due to overcrowding and consequent loss by mortality
5	26-7-1966	*C. mrigala* 4 *L. rohita* 1	,, 1	Nil (unfertilized eggs)	1 pair	Nil	100,000	..
6	27-7-1966	*Catla catla* 1	., 1	Nil (unfertilized)	,,	,,	810,000	..
7	1-5-1966	*C. mrigala* 2	,, 1	2 pairs	,,	200,000	800,000	..
8	9-5-1966	,, 3 *Catla catla* 1	*L. rohita* } *C. mrigala* } 7	1 pair *C. mrigala*	5 pairs	180,000	1,300,000	Hybrids of *L. rohita* and *C. mrigala* were obtained in uninjected pairs
9	9-5-1966	*C. mrigala* 2	*C. mrigala* 1	Nil	Nil	Nil	Nil	..
10	17-5-1966	*C. mrigala* 2 *C. carpio* 3	.. 1	*C. carpio*	1 pair	60,000	40,000	..
11	19-5-1966	*C. mrigala* 2	, 1	Nil	Nil	Nil	Nil	..

TABLE II
Range of chemical conditions of water in which the spawning experiment were done

Temperature	Free CO_2	Phenolphthalein Alkalinity PPM	Methyl Orange Alkalinity PPM	PH value	Dissolved Oxygen mg./h.	Chloride mg/l.	Hardness mg./l.	Specific conductance μ mho	Calcium mg./l.	T.D.S. mg./l.
27.0-32.0	0.0	10-40	145-616	8.2-8.8	4.1-8.5	18.67	112-264	320-800	30.8-38.0	320-376

offspring. Since it is well known that 'Frog test' is used to detect pregnancy in human beings, it was thought possible to use this technique to induce ovulation in fishes. On one occasion when we ran short of pituitary gland, pregnant urine was obtained to supplement it and the two used together. The fish spawned. In order to obviate the effect of pituitary gland, in the next experiment human pregnancy urine alone was injected to *Labeo rohita*. The urine was centrifuged and the supernatant used. In the female fish, a promotor dose of 1·0 c.c. was followed by 1·5 c.c. later. The male received 1·0 c.c. only. The female weighed 2·05 kg. and the male 1·45 kg. Very successful spawning was obtained, resulting in 750,000 hatchlings. Simultaneously, another pair treated with pituitary extract in another *happa* spawned but yielding unfertilized eggs. Several authors[1-3] state that pregnancy urine and Chorionic gondotropins frequently stimulated gondal development. The chief harmonal factor in human pregnancy urine is chorionic gonadotropin which resembles LH in action.[5] Stolk[4] found that certain fishes spawned when injected with human pregnancy urine. Sunder Raj,[5] successfully spawned the cat-fish *Heteropheustes fossilis* with HCG. The finding also has immense possibilities in the spawning of major carps.

These two instances of spawning of major carps in confined cement cisterns are reported for the first time.

Freshwater Biological   V. Ranganathan.
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Bhavanisagar P.O.,   Khaja Ummer.
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EFFECT OF GAMMA-RAYS ON GERMINATION IN *SOLANUM KHASIANUM* CLARKE

A WILD Indian plant, *Solanum khasianum* Clarke, has recently come into prominence as a source for solasodine,[1] a starting material for the synthesis of cortisone. Some data are presented here on the germination behaviour of *S. khasianum* after irradiation of the seeds with gamma-rays.

Seeds of Nilgiris stock were divided into four lots of 200 seeds each. One lot was used as control, the second, the third and the fourth lots were irradiated with gamma-rays (source cæsium-137) at dosages of 1500 *r*, 3000 *r* and 6000 *r* respectively on 15th February 1966. All the seeds were of the same age and were not pre-soaked in water at the time of irradiation. Five days after the irradiation the seeds were sown under uniform conditions in four pots, separate pots being assigned to each treatment and the control. To prevent "damping off", to which the seedlings of *Solanum khasianum* are very prone, the watering was done by placing the pots, which had perforated bottoms, in water and allowing it to percolate from below.

The germination in the control lot commenced on the tenth day after sowing. In Fig. 1 the
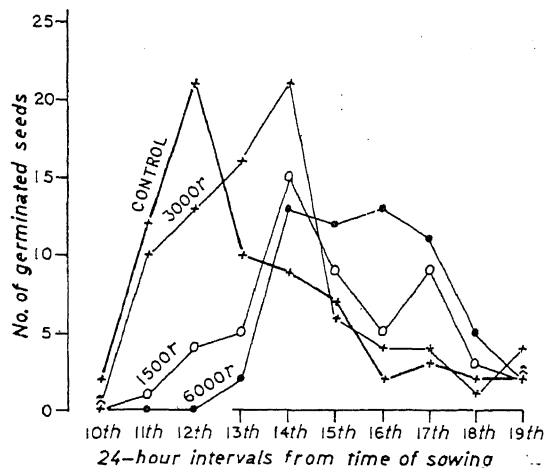
FIG. 1. Progress of germination in control and irradiated lots of 200 seeds each.

number of germinated seeds during 24-hour intervals from the time of sowing have been plotted separately for the control and the three irradiated lots. The maximum germination in the control lot is during the twelfth 24-hour interval from the time of sowing whereas for the 1500 *r* and 3000 *r* lots the maximum germination is during the fourteenth 24-hour interval

from the time of sowing. For the 6000 r lot the peak period of germination is spread over the fourteenth, fifteenth and sixteenth 24-hour intervals from the time of sowing. Thus all the irradiation treatments caused retardation of germination as compared with the control.

Twenty-eight days after sowing 42% of the control seeds had germinated as against 37·5% for the 1500 r treatment, 45% for the 3000 r treatment and 40·5% for the 6000 r treatment. Thus there is no evidence of any significant decrease in germination with increase in dosage at the dosages tried. These observations may be compared with those on grape seeds (Lamarque *et al.*[2]).

In the seedlings from irradiated seeds no malformation of the aerial parts was observed which could be attributed to radiation. This was true not only of the cotyledons but also of the first and second true leaves. However, there was a tendency in the cotyledons to adhere to the seedcoat thus preventing their full and free expansion in a few seedlings from irradiated seeds.

The author expresses his sincere thanks to Dr. B. Mukerji, Director, Chittaranjan National Cancer Research Centre, Calcutta, for according facilities for irradiation and to Shri K. L. Bhattacharya for assisting with the irradiation. The author also thanks Dr. K. Subramanyam for his interest in the investigation.

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PECTIC ENZYME SECRETION *IN VIVO* BY *BOTRYODIPLODIA THEOBROMAE*

IT was recently reported that *Botryodiplodia theobromæ* Pat. caused fruit rot of mango during marketing[1,2] and that the pathogen is capable of attacking fruits of many other plants.[1] In the present communication the author reports the presence of different pectic enzymes in the parasitised tissues of fruits of mango and other plants by this pathogen.

Ripe and fresh fruits were surface-sterilized and inoculated with mycelium of 5 days old culture of *B. theobromæ* growing on PDA. The inoculated fruits were incubated at 25° C. for seven days after which the infected portions were separately removed with the help of blunt

glass spatula and weighed to determine the degree of rot in each case. The infected tissues were then squeezed through muslin, centrifuged and the clear filtrate tested for the presence of protopectinase (PP) by potato disc method and polygalacturonase (PG) and pectin depolymerase (DP) by viscometric methods using 1% sodium polypectate and 1% pectin solutions respectively.[3] The results are given in Table I.

TABLE I

Pathogenecity of the fungus in relation to enzyme secretion

Fruit		Amount of rot in gm.	% of PP	% of PG	% of DP
Capsicum annuum	..	40	38	76	45
Citrus aurantifolia	..	82	*	*	*
Citrus medicalumia	..	45	*	*	*
Mangifera indica var. Kanchan	..	38	*	*	2
M. indica var. Fajli	..	57	*	*	*
M. indica var. Sukul	..	100	*	*	*
Musa sapientum	..	78	*	*	*
Psidum guava	..	76	*	5	7
Pyrus communis	..	82	*	14	2

* Activity less than 0·5%.
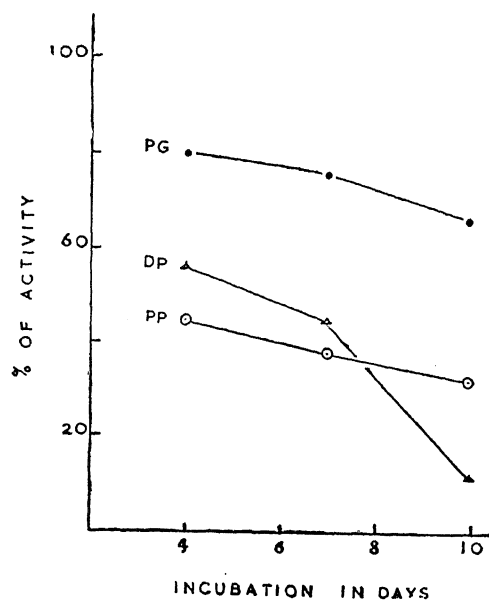
FIG. 1. Activity of pectic enzymes in the sap of parasitised tissues of fruit of *Capsicum annuum*.

It is clear from the results that the pathogen secreted PP, PG and DP enzymes and though the fungus attacked all the fruits used in this study and caused rot in them, the pectic enzymes were not detected in the sap of rotted tissues of all the fruits. There is possibility that due to other chemical changes taking place in the

sap of rotten tissues, the pectic enzymes secreted by the fungus got inactivated. In the case of chilli fruits, there was an indication that the inhibitory compounds inside the host increased with the incubation period (Fig. 1). Formation of such compounds, mostly of phenolic groups, have been reported by different workers in different cases.[4]

Department of Botany,   S. C. GUPTA.
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AN IMPROVED IRON-HAEMATOXYLIN STAINING SCHEDULE FOR MEIOTIC CHROMOSOMES IN PLANTS

BY using suitable mordants and fixatives Wittmann[1] reported success in using iron-hæmatoxylin for staining the chromosomes. He standardised this schedule for squashes for mitotic chromosomes. Lowry[2] and Wittmann[3] extended its use for mushroom and animal chromosomes respectively. It was not known whether meiotic chromosomes in pollen mother cells could be suitably stained. This author trying to study pachytene chromosomes in *Corchorus olitorius* with acetocarmine stain encountered difficulty in getting good preparations. Employing the same schedule of Wittmann,[1] excellent results could be obtained in staining the chromosomes at different stages of meiosis in different materials and particularly in *C. olitorius* where pachytene chromosomes could be stained very bright. The procedure followed was almost the same as described by Wittmann[1] except for the time of fixation, etc.

Flower-buds in suitable stage were fixed in 1 : 3 acetic alcohol (by volume) for two hours in the case of *C. olitorius* and *Sorghum vulgare* and 24 hours for *Gossypium* sp. (sepals and petals were removed before fixation). The fixed materials were kept for 15 to 20 minutes in a specimen tube containing a mixture of iodic acid (0·1 gm.), aluminium alum (0·1 gm.), chrome alum (0·1 gm.) and 95% alcohol (3 ml.) followed by an immediate addition of 3 ml. of conc. HCl. This served as a combined step for mordanting of the tissue. After this the

materials were removed to Carnoy's fluid (6 : 3 : 1) for 30 minutes.

The anthers were then kept on a clean slide with one or two drops of aceto-iron-hæmatoxylin and squashed in usual manner.

For preparation of aceto-iron-hæmatoxylin stain, 4% of hæmatoxylin was dissolved in 45% acetic acid followed by the addition of 1% iron alum. The stain could be used after keeping for 24 hours. Storage of stain in a cool place improved its keeping quality.

Although Wittmann[4] has suggested a permanent type of mounting medium, the slides could be made permanent by passing through acetic acid-*n* butyl alcohol series and mounting in neutral Canada balsam.

Photomicrographs of some preparations obtained by following this schedule are given in Figs. 1 to 6. Figure 4 is from a permanent slide made through acetic acid-*n* butyl alcohol series.

FIGS 1-6. Fig. 1. Pachytene in *Corchorus olitorius*. Note the clear centromere and differential staining of chromomeric pattern, × *ca.* 750. Fig. 2. Diakinesis in *C. olitorius*, × 750. Fig. 3. Metaphase 1 in *C. olitorius*, × 750. Fig. 4. Metaphase I in *Gossypium arboreum* (4x = 52). Microphotograph from a permanent slide, × 750. Fig. 5. Metaphase I in *Sorghum vulgare*, × 500. Fig. 6. Anaphase I in *Sorghum vulgare*, × 500.

Author is deeply grateful to Dr. M. S. Swaminathan, Director, for his interest in the study. Thanks are due to Sri. R. D. Iyer for his help.

Division of Genetics,   O. P. GOVILA.
Indian Agricultural
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DISPERSAL OF CHAROPHYTES BY THE PINTAILS

It is well known that ducks feed on the Charophytes and hence it is presumed that these birds help in the endozoic dispersal of these plants.[1,2] The pintails (*Anas acuta* L.) are the winter visitors to the Ambazari lake in Nagpur. These birds were observed feeding on the aquatic vegetation of the lake particularly on the tips of *Chara corallina* Willd. The lake vegetation consisted of *Nitella hyalina* (De Cond.) Ag.. *Chara corallina* Willd., *C. zeylanica* Willd.. *C. brachypus* Br., *Lychnothamnus barbatus* (Meyen) Leonhardi, *Hydrilla* sp., *Naias* sp.. and *Vallisneria* sp. The intestinal contents of two birds were found to contain parts of *Chara* plants. The microscopic study of the droppings of these birds revealed that the droppings consisted of crushed parts of the stem. 'leaves'. antheridia and oogonia of the *Chara* plants. however. there were also a fairly good number of complete oospores in these droppings. It was therefore thought worthwhile to find out whether these complete oospores present in the droppings are viable or otherwise. For this purpose a good amount of the droppings were mixed with sterilized garden soil and using distilled water was kept in glass bottles. Within a month a number of oospores germinated. Majority of them were found to be of *Chara corallina* and few of *C. zeylanica* and a solitary plant of *Naias minor* Allioni.

The pintails are the migratory birds coming to India from Central Asia.[3] It is therefore quite possible that these birds might be helping in the endozoic dispersal of *Chara corallina* and *C. zeylanica* through their droppings dropped on their ways to and from India.

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College of Science,
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INDUCTION OF ARCHEGONIA IN *POHLIA NUTANS*

Pohlia nutans (Hedw.) Lindb., a common paroicous moss, has been maintained[1] in aseptic cultures for the last ten years. In the beginning, half-strength Knop's nutrient solution was used as a basal medium, but later, a modified Voth's medium[2] has been used for sub-culturing at monthly intervals. During this long period, small masses of protonemal filaments of *P. nutans* from the sub-cultures were used as inocula for various experiments on protonemal growth and bud formation. Until recently, gametangia have not been formed in the leafy shoots of any of the cultures. It appeared, therefore, that the clone was a sterile one. During some recent nutritional studies, however, archegonia, but no antheridia, were found on the leafy shoots (Fig. 1). Results were con-

FIG. 1. Induced archegonia in the tip of a shoot of *P. nutans.*

firmed by replication of the experiments. Of the modifications of Voth's cation and anion nutrient solutions,[3] only the one in each series which produced the maximum number of gemmæ cups in *Marchantia polymorpha*, supplemented with urea at 0, 5, 10, 15, 25 and 50 mg./l. concentrations, were used. The cultures were

TABLE I

Effects of urea on the formation and development of buds and archegonia when added to two kinds of nutrient solutions

Effects	Concentrations of urea in mg./litre					
	0	5	10	15	25	50
Total No. of buds ..	8, (0)	46, (0)	105, (0)	120, (27)	143, (9)	91, (7)
Per cent. of buds developed into leafy shoots	0, (0)	0, (0)	43, (0)	85, (73)	90, (0)	83, (0)
No. of archegonia per head ..	0, (0)	0, (0)	1–2, (0)	3–4, (rarely 1–2)	3–4, (0)	0, (0)
Per cent. of leafy shoots with archegonia	0, (0)	0, (0)	8, (0)	23, (0)	30, (0)	0, (0)

N.B.—Results were averages of 5 similar nutrient agar cultures of 47 days old. The two series of numbers given in the table—numbers as such and numbers within brackets represent results from *anion* and *cation* series respectively.

kept under the usual regime of light and temperature conditions.[4]

The principal results of the treatments appear in Table I. Archegonia did not appear in plants growing without urea. The occurrence of archegonia and the number per head were highest in the *anion* series with 25 mg./l. of urea.

Archegonia were found in heads containing perichætial leaves which were distinctly larger than the ordinary leaves. The appearance of the perichætial leaves seemed to be a prelude to the appearance of archegonia. There were no marked differences between cultures containing 15 mg./l. and 25 mg./l. of urea; but, in the treatment containing 50 mg./l. urea, although the leafy shoots developed, archegonia were completely inhibited. In the *anion* series, the number of archegonia per head and their frequency decreased progressively with the progressive decrease in the concentration of the urea. In the *cation* series, containing 15 mg./l. urea only, archegonia were rare and then largely undeveloped. Apart from the wide variation in the induction of archegonia in the *cation* and *anion* series, several alterations in development occurred. These are summarized in Table I.

The results show the graded effect of the different concentrations of urea on the formation of shoot buds, their development into leafy shoots, and the induction of archegonia. It is also clear that the induction of archegonia by urea was limited by the presence of a combination of macro-salts of the *anion* series only, and that the cultural conditions prevented induction of antheridia. It is noteworthy that during this long period of growth of the gametophytes in aseptic culture, the urea factor which favoured the formation of archegonia, or a precursor for their formation, did not change, but was effective only when coincident with the required nutrients and favourable light and temperature conditions. It seems that the sterile moss plants which are found in nature may be sterile because of unfavourable edaphic factors. For reference, Noguchi's[5] observations of the sporulation of two Japanese *Merceya* species (*M. ligulata* and *M. gedeana*) may be stated. He did not find any sporangia in specimens collected from Europe, N. and S. America and Java, but found good sporophytes in specimes from N.W. Himalayas, Formosa and Japan.

Tissue Culture Laboratory,   G. C. MITRA.
National Botanic Gardens,
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REVIEWS AND NOTICES OF BOOKS

Transition Metal Chemistry. (Volumes 2 and 3.)
Edited by Richard L. Carlin. (Marcel Dekker,
Inc., 95, Madison Avenue, New York), 1966.
Volume 2 : Pp. ix + 350. Price $ 14.75.
Volume 3 : Pp. ix + 359. Price $ 15.75.

This series is devoted to the science of the
transition elements and is geared to research
scientists, graduate students, and teachers of
advanced inorganic chemistry. As transition
metal chemistry is one of the oldest and largest
areas of research in inorganic chemistry, the
many facets of its progress will be surveyed
regularly, attention being paid to both theoreti-
cal and experimental aspects, as well as the
borderline areas. New subjects of transition
metal physics and transition metal biology will
also be reviewed as it is here that some of the
more important future discoveries will be made.
The editor has been able to secure the co-opera-
tion of outstanding scientists in this field,
whose contributions will be up-to-date reviews
of subjects of the highest current interest.

Volume 2 of this series contains the following
chapters : Reactions of Ligands Co-ordinated
with Transition Metals, by James P. Collman ;
Transition Metal Ions as Reagents in Metallo-
enzymes, by A. E. Dennard and R. J. P.
Williams ; Optical Activity in Inorganic and
Organic Compounds, by Andrew D. Liehr.

Volume 3 of this series contains the follow-
ing chapters : Electronic Structures of Some
Organometallic Molecules, by David A. Brown ;
Equilibria of Complexes in Non-aqueous
Solvents, by Leonard I. Katzin ; Electron Spin
Resonance of Transition-Metal Complexes, by
Bruce R. McGarvey ; Fluorescent Lifetimes of
Trivalent Rare Earths ; Conformations of Co-
ordinated Chelates, by A. M. Sargeson.

C. V. R.

Non-linear Differential Equations. By T. V.
Davies and E. M. James. (Addison-Wesley
Publishing Company), 1966. Pp. ix + 274.
Price $ 12.75.

The scope of this book is indicated by the
titles of the chapters contained therein, *viz.*,
1. Autonomous Differential Equations of the
Second Order ; 2. Singular Points ; 3. Cycles
without Contact and Limit Cycles ; 4. Special
Investigations of Lienard and LaSalle ; 5. The
Small-Parameter Method of Poincare and its

Extension ; 6. Differential Equations in which
a Small Parameter is Associated as a Factor
with the Differential Coefficient of the Highest
Order ; 7. Theory of Centres and its Application
by Bautin in a Limit Cycle Investigation ;
8. Stability Theory and the Use of Liapunov
Functions ; 9. Differential Equations of the
Second Order with a Forcing Term.   C. V. R.

Problems in Particle Physics. By Kamal.
(McGraw-Hill Publishing Co. Ltd., London),
1966. Pp. vii + 126. Price 38 *sh.*

Bearing the needs of the experimental
physicist constantly in mind, this is the first
book to be written solely on problems in ele-
mentary particle physics. Its purpose is to
familiarize the student of experimental high
energy physics with the tools of theoretical
physics which he is likely to use most fre-
quently. Not only is the subject presented in
a stimulating and assimilable form, but infor-
mation, often not found in more conventional
texts, is also introduced, as well as ample
bibliographical material.

Assuming a good knowledge of quantum
mechanics, and some knowledge of quantum
field theory, the book will be used by first and
second year graduate students in experimental
high energy physics, or in conjunction with a
conventional course in quantum field theory.

C. V. R.

Advances in Chromatography (Vol. 2). Edited
by J. Calvin Giddings and Roy A. Keller.
(Marcel Dekker, Inc., 95, Madison Avenue,
New York), 1966. Pp. xvi + 377 : Price $ 14.50.

The present volume is dealt with in two
parts, *viz.*, I. General Chromatography and
II. Gas Chromatography.

Part I contains the following chapters : Ion
Exchange Chromatography of Amino-Acids :
Recent Advances in Analytical Determinations,
by Paul B. Hamilton ; Ion Mobilities in Electro-
chromatography, by John T. Edward ; Partition
Paper Chromatography and Chemical Structure,
by J. Green and D. Mchale ; Gradient Tech-
niques in Thin-Layer Chromatography, by A.
Niederwieser and C. V. Honegger ; and Geology
—An Inviting Field to Chromatographers, by
Arthur S. Ritchie.

Part II contains the following chapters :
Extracolumn Contributions to Chromatographic

Band Broadening, by James C. Sternberg; Gas Chromatography of Carbohydrates, by James W. Berry; Ionization Detectors for Gas Chromatography, by Arthur Karmen; and Advances in Programmed Temperature Gas Chromatograpy, by Louis Mikkelsen.   C. V. R.

Advances in Astronomy and Astrophysics (Vol. 4). Edited by Zdenek Kopal. (Academic Press, New York and London), 1966. Pp. ix + 346. Price $ 14.00.

Volume 4 of this well-known series contains the following sections: Objective Prisms and Measurement of Radial Velocities, by Ch. Fehrenbach; The Figure and Gravity Field of the Moon, by C. L. Goudas; The Relativistic Degenerate Gas, by A. W. Guess; Exchange of Matter and Period Changes in Close Binary Systems, by A. Kruszewski; The Stray Bodies in the Solar System. Part II. The Cometary Origin of Meteorites, by Ernst J. Opik.
C. V. R.

Atomic Energy and Its Applications (Second Edition). By J. M. A. Lenihan. (Sir Isaac Pitman and Sons Ltd., Pitman House, Parker Street, Kingsway, London W.C. 2), 1966. Pp. 336. Price 45 *sh*. net.

The first edition of this Pitman hand-book in the Applied Physics Series was published in 1953 to provide the general reader with a simple account of the Fundamentals of Nuclear Science, Current Applications of Atomic Energy, and its future prospects. For the second edition the text has been revised taking into account the progress that has since been achieved in the applications of atomic energy in many areas of industry, agriculture, medicine, etc. A new chapter on thermonuclear reactions has been added.   A. S. G.

Experimental Nucleonics. By B. Brown. (Iliffe Books Ltd., Dorset House, Stamford Street, London S.E: 1), 1966. Pp. 245: Price 12 *sh*. 6 *d*. net (by post 13 *sh*. 5 *d*.).

The book describes some 50 experiments under different groups such as physical constants, electronics, counting systems, radioactivity, neutron detection, health physics and photographic techniques. Each experiment is described under the headings: Apparatus, Theory and Procedure. Some of the experiments require advanced instruments as may be available only in colleges and universities, but

quite a number of experiments described can be carried out with equipment ordinarily to be had in modern advanced course schools which include modern physics in their science curriculum.   A. S. G.

Handbuch Der Kolorimetrie. By B. Kakac and Z. J. Vejdelek. (Published by Veb Gustav Fischer Verlag Jena, 69, Jena, Villengang, 2/Postschliessfach No. 176), 1966. Band III— Part 1, Pp. 1–857, Price MDN 76; Part 2, Pp. 859–1354), Price MDN 49.60.

The third volume of this comprehensive treatise *Handbook of Colorimetry* (in German) follows the same distinguishing pattern set-up in the two previous volumes reviewed earlier (see *Curr. Sci.*, March 1963 and November 5, 1964). Volume III devoted to Colorimetry in Biology, Biochemistry and Medicine, is issued in two parts: (1) Organic Compounds and (2) Inorganic Compounds.

The organic part contains four chapters. The first chapter deals with amino salts, proteins and peptides. The second chapter on carbohydrates deals firstly with monosaccharides and oligosaccharides and their derivatives, then with polysaccharides, and lastly with carbohydrates in combination with other compounds. The third chapter is devoted to steroid compounds, and the last chapter is concerned with such compounds of biological interest as C–H–O compounds, C–H–N and C–H–N–O compounds, and C–H–N–O–(X) compounds. The text contains 77 figuhes of absorption curves.

The inorganic part deals with the colorimetry of 40 elements and their compounds. The actual text is of 360 pages with 44 figures. The remaining about 140 pages are devoted to author index for the two parts.

The *Handbook of Colorimetry* is an essential addition to all chemical, pharmaceutical, biological and medicinal laboratories as a ready reference book.   A. S. G.

Books Received

Annual Review of Physical Chemistry (Vol. 17). Edited by H. Eyring. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306), 1966. Pp. vii + 587. Price $ 9.00.

Nutrition—A Comprehensive Treatise (Vol. III): *Nutritional Status Assessment and Application*, Edited by G. H. Beaton and E. W. Mchenry. (Academic Press, New York), 1966. Pp. xvii + 349. Price $ 15.00.

CRYSTAL STRUCTURE OF L-TRYPTOPHAN HYDROBROMIDE*

R. RAMACHANDRA AYYAR** AND R. CHANDRASEKHARAN

Centre of Advanced Study in Physics, University of Madras, Madras-25, India

1. INTRODUCTION

L-TRYPTOPHAN is an essential amino-acid and is known to be transformed into nicotinamide in biosynthesis. The determination of the crystal structure of L-tryptophan hydrobromide was taken up as part of the major work on the structural studies of amino-acids and peptides in this laboratory. The structure was determined in both the projections down the b and c-axes and then refined using three-dimensional data by the method of least squares. While the detailed report on the structure was being prepared for publication, it was brought to the notice of the authors that this structure has been determined elsewhere recently.[1] The present determination of the structure has been carried out independently with the hydrobromide and the features of the structure agree well in all essential details with those of Takigawa et al., who have analysed the structure in the hydrochloride form which could therefore be expected to be more accurate. For this reason, a detailed discussion of the hydrobromide structure and the conformational features of the tryptophan molecule will not be given. This paper will therefore deal with only an outline of the method of attack in solving the structure and a comparative study of the structures of the hydrochloride and the hydrobromide.

2. EXPERIMENTAL

The crystallographic data for the hydrobromide are given below:

Cell dimensions: $a = 14 \cdot 57$, $b = 5 \cdot 44$, $c = 7 \cdot 57$ Å and $\beta = 99 \cdot 6°$;

Space group: $P2_1$;

Contents of the unit cell: $2(C_{11}H_{11}N_2O_2 . HBr)$;

Calculated density: $1 \cdot 581$ g./c.c.; Measured density: $1 \cdot 583$ g./c.c.;

Linear absorption coefficient μ : $51 \cdot 0$ cm.$^{-1}$ (for CuKα).

Three-dimensional intensity data were collected using the multiple film equi-inclination Weissenberg technique. 1220 reflections were recorded with CuKα radiation ($\lambda = 1 \cdot 5418$ Å) for the layers with K $= 0, 1, 2, 3$ and 4 about

2

the needle axis b and the h k 0 reflections about the c-axis. All the intensities were estimated visually by comparison with a standard set of spots recorded with the same crystal. These were corrected for the Lorentz and polarisation factors and placed on the absolute scale by layerwise Wilson plots. The h k 0 reflections were used for correlating the different layer intensities. Absorption corrections were not applied as the crystal thickness was less than $0 \cdot 2$ mm.

3. DETERMINATION AND REFINEMENT OF THE STRUCTURE

The Lp sharpened Patterson projection down the b-axis gave the x and z co-ordinates of the bromine atom. Using the bromine atom for the known part, a weighted beta general synthesis[2] for this projection was computed (Fig. 1) which gave the structure straight
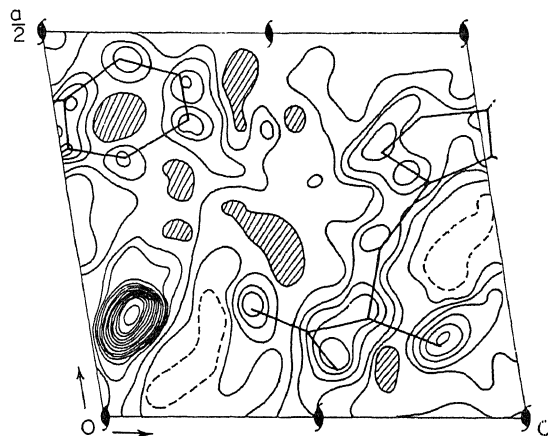
FIG. 1. Weighted β-general synthesis b-axis projection. Contours are drawn at intervals of 4e/A². Zero contours are indicated by dashed lines.

away. The R-index for the trial structure for the h 0 l reflections was $0 \cdot 250$ compared with the value of $0 \cdot 380$ given by the bromine alone. The structure was refined in the projection by difference Fourier syntheses to an R-index of $0 \cdot 200$. The difference Fourier maps showed considerable anisotropic thermal vibration for the bromine atom.

For the projection down the c-axis, the y-co-ordinate of the bromine atom was arbitrarily chosen to be $0 \cdot 25$. As before, a weighted beta general synthesis was computed.

Because of the spurious mirror symmetry introduced by the bromine phases, lot of over-lapping was observed in the map. However, from stereochemical considerations and with the aid of the map in the b-projection, the molecule could be identified and approximate y-co-ordinates were assigned to all the atoms. The R-index for the $hk0$ reflections for this model was 0·290.

This model was used for the three-dimensional refinement of the structure by least squares.

refinement from the residuals and the diagonal elements of the inverse matrix of the normal equations. The final R-index was 0·112 for all the reflections, and 0·103 when the unrecorded reflections were omitted.

4. RESULTS AND DISCUSSION

The final positional parameters, their standard deviations and the thermal parameters of the atoms of a molecule are given in Table I. The final electron density maps for the b and c-axes

TABLE I

Final atomic co-ordinates (fractional) and their standard deviations in Angstroms and thermal parameters

Atom	Positional co-ordinates			Standard deviations			Thermal parameters					
	x	y	z	$\sigma(X)$	$\sigma(Y)$	$\sigma(Z)$	B_{11}	B_{22}	B_{33}	B_{12}	B_{13}	B_{23}
				(in Angstroms)			$\times 10^4$					
Br	0·1251	0·2500	0·1026	0·0027	0	0·0018	46	293	164	38	52	−121
O_1	0·1487	0·6529	0·4069	0·0180	0·020	0·017	111	321	76	− 80	76	− 26
O_2	0·0757	0·4189	0·5812	0·015	0·019	0·017	58	154	247	−122	56	−176
N_1	0·0961	0·7469	0·8446	0·0 7	0·020	0·015	33	4.7	111	0	38	−113
N_2	0·3963	0·3800	0·8469	0·020	0·022	0·018	48	301	196	− 17	75	67
C_1	0·1130	0·6012	0·5507	0·020	0·018	0·020	28	238	195	76	−23	−155
C_2	0·1342	0·8246	0·6853	0·018	0·022	0·017	34	10	128	24	− 3	12
C_3	0·2367	0·9054	0·7309	0·020	0·024	0·021	9	286	208	18	− 8	14
C_4	0·2983	0·7041	0·8068	0·020	0·022	0·016	39	47	129	− 25	44	37
C_5	0·3393	0·6868	0·9948	0·017	0·018	0·017	3 4	40	122	5	36	− 3
C_6	0·3285	0·8323	1·1450	0·016	0·019	0·017	29	228	115	− 30	3	− 17
C_7	0·3849	0·7585	1·3128	0·022	0·023	0·022	53	575	159	− 9	− 57
C_8	0·4393	0·5504	1·3245	0·020	0·033	0·020	34	390	204	− 27	76	75
C_9	0·4487	0·4026	1·1804	0·021	0·022	0·020	32	276	134	− 22	4	156
C_{10}	0·3973	0·4870	1·0200	0·021	0·024	0·018	26	189	193	− 73	20	−158
C_{11}	0·3336	0·5092	0·7270	0·018	0·024	0·019	29	287	133	43	25	− 23

Temperature factor $= \exp - (B_{11}h^2 + B_{22}k^2 + B_{33}l^2 + B_{12}hk + B_{13}hl + B_{23}kl)$.

In all, eleven cycles of refinement were run which reduced the R-index from 0·310 to 0·110. The first two cycles of refinement were carried out on the Elliot 803 computer using a pro-gramme written by Subramanian[3] for the space group $P2_1$. The next seven cycles of refinement were run on the IBM 1620 computer and the last two cycles again on the Elliot 803 computer using the programmes of Mair.[4] The first nine cycles of refinement were carried out with individual isotropic thermal parameters for the atoms. The last two cycles of refinement were anisotropic, block diagonal refinements, in which the three positional and the six thermal parameters were varied together with the layerwise scale factors. Unit weighting scheme was used throughout. Unrecorded reflections were included in the final stages of refinement, by assigning them with half the minimum |Fo| observed in the local sin θ range. The standard deviations were estimated at the end of the

projections are shown in Figs. 2 and 3 respec-tively. The structure viewed along the b and c-axes is shown in Figs. 4 and 5 respectively.

The bond lengths and bond angles in the molecule are given in Table II a and shown in Fig. 6. Table II b gives the standard deviations in bond lengths and angles. Most of the bond lengths and bond angles in the two structures are found to be very nearly equal. Small differences in the bond lengths observed for C^α–N, C_6–C_7 and C_{10}–N_2 in the two structures are not really significant in view of the standard deviation in bond length in the hydrobromide being 0·02 Å. In both the structures, the bond dis-tance C_{10}–N_2 is significantly larger than the value (1·307 Å) found in glycyl-L-tryptophan.[5] A probable reason for this shortening observed in glycyl-L-tryptophan is given by Takigawa *et al.*

In the carboxyl group, the two C–O bond lengths are 1·31 Å and 1·17 Å values close to

single and double bond length in a pure carboxyl group[6]; also, the bond angles observed in this group suggest pure carboxyl group character.
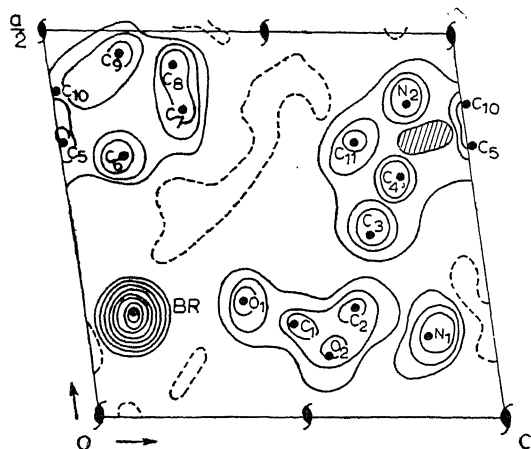
FIG. 2. Final electron density map b-axis projection. Contours are drawn at intervals of $2e/A^2$ except near bromine where they are at $5e/A^2$. Zero contours are dashed.
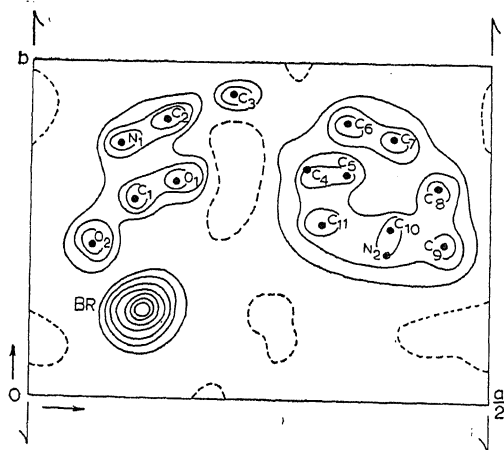
FIG. 3. Final electron density map c-axis projection. Contours are drawn as in Fig. 2.
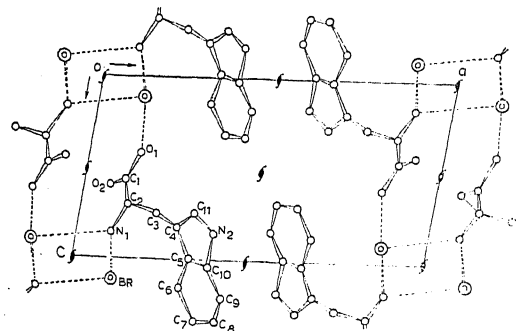
FIG. 4. A view of the structure looked along the b-axis.
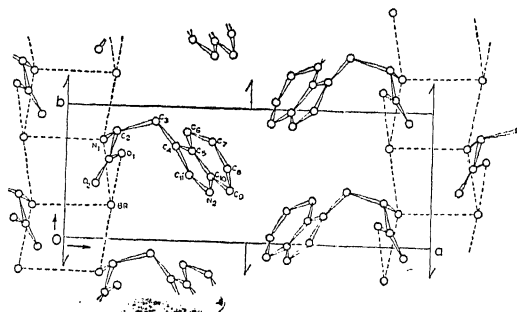
FIG. 5. A view of the structure looked along the c-axis
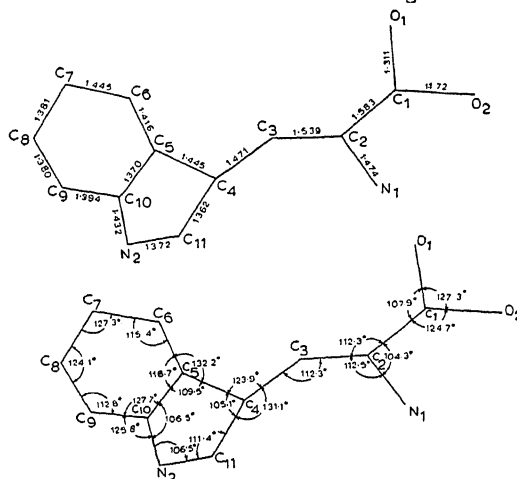
FIG. 6. Bond lengths and bond angles in the molecule.

TABLE II a

Bond lengths and bond angles in a molecule

Bond lengths

Bond	Bond length (in Angstroms)	Bond	Bond length (in Angstroms)
C_1-O_1	1·311	C_6-C_7	1·445
C_1-O_2	1·172	C_7-C_8	1·381
C_1-C_2	1·583	C_8-C_9	1·380
C_2-C_3	1·539	C_9-C_{10}	1·394
C_2-N_1	1·474	$C_{10}-N_2$	1·432
C_3-C_4	1·471	N_2-C_{11}	1·372
C_4-C_5	1·445	$C_{11}-C_4$	1·362
C_5-C_6	1·416	$C_{10}-C_5$	1·370

Bond angles

Bond angle	Angle in degrees	Bond angle	Angle in degrees
$O_1-C_1-O_2$	127·3	$C_4-C_5-C_6$	132·2
$O_1-C_1-C_2$	107·9	$C_{10}-C_5-C_6$	118·7
$O_2-C_1-C_2$	124·7	$C_5-C_6-C_7$	115·4
$C_1-C_2-N_1$	104·3	$C_6-C_7-C_8$	121·3
$C_1-C_2-C_3$	116·2	$C_7-C_8-C_9$	124·1
$N_1-C_2-C_3$	112·4	$C_8-C_9-C_{10}$	112·8
$C_2-C_3-C_4$	112·4	$C_9-C_{10}-C_5$	127·7
$C_3-C_4-C_5$	123·9	$C_9-C_{10}-N_2$	125·8
$C_3-C_4-C_{11}$	131·1	$C_5-C_{10}-N_2$	106·5
$C_{11}-C_4-C_5$	105·1	$C_{10}-N_2-C_{11}$	106·5
$C_4-C_5-C_{10}$	109·5	$C_4-C_{11}-N_2$	111·4

TABLE II b
*Average standard deviations in bond lengths
and bond angles*

C–C (linear chain)	..	0·020 Å
C–C (aromatic ring)	..	0·023 Å
C–N	..	0·018 Å
C–O	..	0·020 Å
Bond angles	..	1·25°

The indole ring is planar as observed in the hydrochloride. The beta carbon atom also lies nearly in this plane. The amino nitrogen is planar with the C^α–COOH group. It is elevated only by 0·003 Å from this plane; the corresponding value in the hydrochloride is 0·15 Å.

All the protons available in a molecule are involved in hydrogen bonding (Table III). The

hydrogen bond O_1–H...Br^-, which is nearly parallel to the b c plane, helps to stabilise the structure in this plane by cross-linking the two spiral networks of hydrogen bonds that are translated in the c-direction. However, two consecutive spiral networks of hydrogen bonds that are translated in the a-direction are separated from each other by two molecules, related by symmetry, which are held together only by van der Waals forces between the atoms of the indole rings.

The non-bonding intermolecular contacts less than 4·0 Å are given in Table IV. There are no unusually short contacts.

We wish to thank Professor G. N. Ramachandran for helpful guidance and Professor R. Srinivasan for many useful discussions. We are grateful to the Government of India and

TABLE III
Hydrogen bond lengths and bond angles

Bond	Bond length in Å	Bond angle	Angle in degrees
N_1–H ... Br (A_{001})	3·32	C_2–N_1–Br (A_{001})	133·4
N_1–H ... Br (A_{011})	3·35	C_2–N_1–Br (A_{011})	102·4
N_1–H ... Br (B_{001})	3·31	C_2–N_1–Br (B_{001})	127·2
O_1–H ... Br	3·14	C_1–O_1–Br	116·7
		Br (A_{001}) ·· N_1 ·· Br (A_{011})	109·3
		Br (A_{001}) ·· N_1 ·· Br (B_{001})	92·0
		Br (A_{011}) ·· N_1 ·· Br (B_{001})	92·5

Note : Molecule A is at (x, y, z), B is at $(1 - x, \frac{1}{2} + y, 1 - z)$, A_{001} is at $(x, y\ 1 + z)$, etc.

amino nitrogen existing as NH_3^+ forms three hydrogen bonds of the type N–H...Br of lengths 3·32 Å, 3·35 Å and 3·31 A. The carboxyl oxygen atom O_1 forms the fourth hydrogen bond O_1–H...Br = 3·14 Å. The hydrogen bond directions from the amino nitrogen are pointing nearly tetrahedrally towards the three bromide ions with respect to the bond N–C^α. A significant feature of the structure is that while the carboxyl oxygen O_1 is involved as a donor in hydrogen bonding, the other oxygen O_2 does not take part in any hydrogen bonding even as an acceptor. This again suggests the existence of pure carboxyl group in the structure.

The scheme of hydrogen bonds may be seen in Figs. 4 and 5. The stability of the structure is maintained by a fine spiral network of hydrogen bonds linking the polar group NH_3^+ and Br^- of the molecule and infinitely extending along a screw axis. Two such spiral networks are related by unit translation along the c and a-axes directions. Around the screw axes that occur midway between these spiral networks, there are only weak van der Waals forces holding the different molecules together. The strong

TABLE IV
Non-bonding inter-molecular contacts less than 4 Å

Atom		distance	Atom		distance
from	to		from	to	
Br (A_{010})	O_1	3·96	O_2(B_{001})	O_2	3·59
Br (A_{001})	O_2	4·00	O_2(B_{001})	N_1	3·85
Br (A_{011})	C_2	3·94	O_2(B_{001})	C_1	3·26
Br (A_{011})	C_3	3·95	O_2(B_{001})	C_2	3·41
Br (A_{011})	C_6	3·71	O_2(B_{011})	O_2	3·59
O_1 (A_{001})	C_6	3·67	N_2(B_{101})	C_6	4·00
O_1 (A_{001})	C_7	3·67	N_2(B_{101})	C_7	3·66
O_2 (A_{010})	C_2	3·40	N_2(B_{101})	C_8	3·42
O_2 (A_{010})	C_3	3·70	N_2(B_{101})	C_9	3·42
N_2 (A_{010})	C_3	3·49	N_2(B_{101})	C_{10}	3·69
N_2 (A_{010})	C_4	3·94	N_2($B_{1\bar{1}1}$)	C_9	3·66
N_2 (A_{010})	C_6	3·96	N_2(B_{102})	C_5	3·98
C_9 (A_{010})	C_6	3·55	C_4($B_{1\bar{1}1}$)	C_9	3·83
C_9 (A_{010})	C_7	3·81	C_5($B_{1\bar{1}1}$)	C_9	3·75
C_{10}(A_{010})	C_6	3·86	C_7($B_{1\bar{1}1}$)	C_8	3·78
C_{11}(A_{010})	C_3	3·58	C_8($B_{1\bar{1}1}$)	C_8	4·00
C_{11}(A_{010})	C_7	3·60	C_8 (B_{101})	C_8	4·00
C_{11}(A_{010})	C_8	3·61	C_9(B_{102})	C_{11}	3·79
O_1(B_{001})	O_2	3·59	C_9(B_{101})	C_{10}	3·69

for grant of study leave. We would like to thank the authorities of the Fundamental Engineering Research Establishment, Madras, Hindustan Aeronautics Ltd., Bangalore and the Tata Institute of Fundamental Research, Bombay, for making computer facilities available.

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PLASMA PROTEIN CHANGES IN EXPERIMENTAL CANCER (YOSHIDA ASCITES SARCOMA IN RATS)

V. V. SUBBA REDDY, V. SRINIVASA RAO AND M. SIRSI

Pharmacology Laboratory, Indian Institute of Science, Bangalore-12

MALIGNANT tumours are known to alter the plasma proteins of the host both qualitatively and quantitatively.[1,2] Many attempts have been made to detect specificity in the pattern of changes to facilitate diagnosis and prognosis of the malignant states. The presence of certain specific proteins have been claimed with certain type of tumours.[3]

The present study relates to the qualitative and quantitative alterations in the serum proteins of rats bearing Yoshida ascites sarcoma. This sarcoma originated in the ascites form in a rat treated with O. amidoazotoluene and Fowler's solution,[4] and has been maintained in ascites form since by serial transplantations in rats. The nature of cancer cell is uncertain. Originally considered to be reticulo-endothelial in nature,[5] recently the tumour is thought to have an epithelial origin.[6]

For our studies the tumour injected rats were obtained from the Indian Cancer Research Centre, Bombay. They have been maintained in highly inbred Wistar strain of rats. This sarcoma—a rapidly developing tumour causes mortality in hundred per cent of the infected animals within ten days of implantation.

MATERIALS AND METHODS

Male rats weighing 100–120 grams, infected with 100 million cells, were used for the studies.

Heart blood and ascitic fluid were obtained from the transplanted rats on the 8th day when maximal ascites had developed. Separated serum and the supernatant of the ascitic fluid were stored in cold. Normal rat serum served as control.

Total proteins in the sera were estimated by Biuret method[7] after treating with TCA. Analysis of the serum components was carried out by agar-gel electrophoresis[8] at 300 v with constant current of 10–12 mA running for a period of 6 hours. Each stained protein band was estimated by elution method, using cellophane paper technique.[9] The bands were eluted in N/20 NaOH and the color read in Klett-Summerson photoelectric calorimeter using filter 54.

Results are presented in Table I and Figs. 1 and 2.

TABLE I

Serum proteins in normal and tumour-bearing rats

Sample	% of proteins in grams
Normal rat serum ..	6·2*
Tumour-bearing rat serum ..	4·5*

* Each value represents the average of 3 experiments.

Note : Reduction in protein content of serum from tumour-bearing rats.

RESULTS AND DISCUSSION

The results indicate :

(*i*) reduction in the total protein content,

(*ii*) hypoalbuminemia,

(*iii*) slight elevation of α and β-globulins,

(*iv*) complete absence of γ-globulin in the sera of tumour-bearing animals, and

(*v*) a similar pattern of the components with absence of γ-globulin in the ascitic fluid.

Hypoproteinemia and reduction in albumin can result from malnutrition, but this is usually associated with increased γ-globulin. Similarly, the reduced albumin occurring in many diseases, injury, burns and reactions to stress is invariably accompanied by elevated γ-globulin.[10] Hence, while malnutrition may partly be responsible for the hypoproteinemia and diminished albumin in the sera of Yoshida sarcoma rats due to diminished food intake in the later stages of tumour development, the

absence of γ-globulin needs explanation. The reduced protein and albumin in the tumour rat may also result by the depletion from the blood and accumulation of these components in the ascitic fluid exudate.

In the various types of malignancies seen in the human, the changes reported are hypoproteinemia, albumin reduction, α_1 and α_2 globulin increase, but no significant changes in β and γ-globulin levels.[11]

The low levels and complete absence of γ-globulin seen in Yoshida sarcoma resemble the effects of neoplasms of lymphocyte plasmocyte series, *viz.*, lymphoma, chronic lymphatic leukemia, and thymic tumours. In these tumours the reduction in γ-globulin is attributed to the loss of specialised function in the cancer cell, *i.e.*, the ability to synthesize the immune globulins.[12] Yoshida sarcoma, unlike these malignant cells, is not considered to be a tumour related to immunologically competent cells and develops in the peritonium outside the circulation.

Whether immune globulin synthesis is impaired by the toxins of Yoshida sarcoma cells or suppression of the growth of immunologically competent cells themselves is involved in the causation of hypo and agammaglobulinemia observed in the tumour bearing rat needs elucidation.
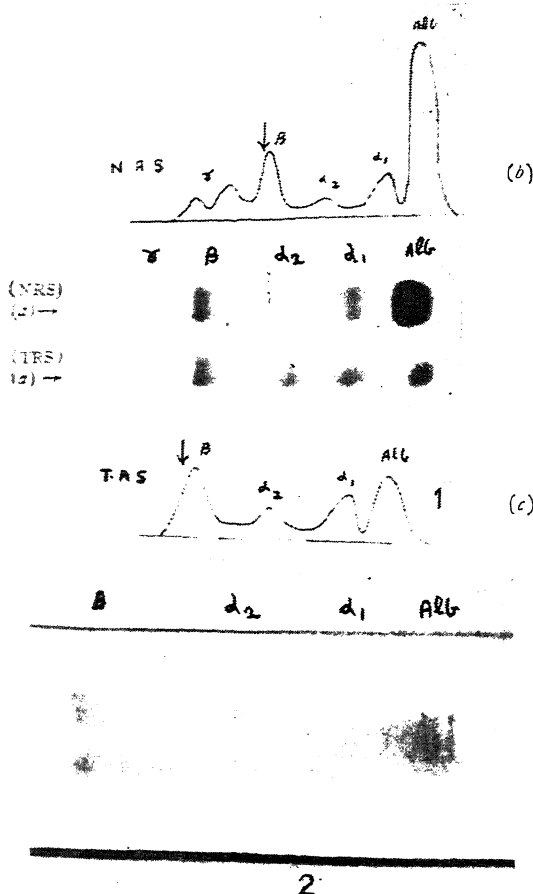
FIGS. 1–2. Fig. 1. Agar-gel electrophoretogram of normal and tumour-bearing rat sera. (*a*) NRS—Normal rat serum; TRS—Tumour rat serum, (*b*) Elution of normal rat serum, (*c*) Elution of tumour-bearing rat sera. Note: Absence of γ-globulin and reduction in albumin with slightly elevated α, β globulins in *c*. Fig. 2. Agar-gel electrophoretic pattern of peritonial fluid from tumour-bearing rat. Note: Absence of γ-globulin.

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SOLID STATE INTERACTION, AN IMPORTANT FACTOR IN REVERSIBILITY AND REPRODUCIBILITY OF ELECTRODES OF THE SECOND KIND

K. S. INDIRA AND K. S. G. DOSS

Central Electrochemical Research Institute, Karaikudi, India

IT has been recently reported[1] that the electromotive force (e.m.f.) of the cell comprising $Ag(s)/AgCl(s) \ KCl_{aq} \ (c)Hg_2Cl_2(s)/Hg$ (1) when measured at different concentrations of the KCl solution shows a systematic increase in the value as shown in Table I.

TABLE I
E.m.f. of the cell $Ag(s)/AgCl(s)KCl_{aq}$ (c) $Hg_2Cl_2(s)/Hg(1)$

Concentration of KCl	E.m.f.
1 M	0·04552 V
0·1 M	0·04566 V
0·01 M	0·04612 V
0·001 M	0·048 V

The cell reaction of the system is given by
$\frac{1}{2} Hg_2Cl_2$ (s) $+ Ag$ (s) $\rightarrow AgCl$ (s) $+ Hg$ (1).
The standard e.m.f. of the cell should therefore have the same value irrespective of the concentration of the common electrolyte, in contrast to what is reported above.

El Constantinescu[1] has taken notice of this and interpreted the observed change as caused by the liquid junction potential arising from the fact that one of the electrodes has a solution saturated with silver chloride whereas the other is having a solution saturated with mercurous chloride. A simple calculation would show that the liquid junction potential in such a system even in the most dilute solution of potassium chloride tried herein would not amount to more than a few microvolts.

The dependence of the potential of the system on the chloride concentration in aqueous phase may be caused by either thermodynamic factors affecting reproducibility or kinetic factors affecting reversibility. Poor reversibility would lead to erratic variation of potential whenever a small current is drawn during measurement; the potential may be also upset in an unsystematic way by the interaction of reducible or oxidisable impurities present with the redox system under study. In view of the fact that the deviations observed are markedly systematic it is our opinion that the thermodynamic factors are playing the main role. This conclusion is rendered further plausible by the facts that (*a*) the potentials of the electrodes being on the positive side, the normal reducible impurities would not appreciably interfere, (*b*) with the present measuring techniques, upsetting of potential by any appreciable current being drawn from the system, is not a problem.

SOLID STATE EFFECTS AND REPRODUCIBILITY

The e.m.f. of the cell under consideration is given by the equation

$$E = \frac{1}{F} \ [\frac{1}{2} \ G_{Hg_2Cl_2} + G_{Ag} - G_{AgCl} - G_{Hg}].$$

$$(1)$$

The invariability of the electromotive force of the system is dependent on the invariability of the activities of (*a*) liquid mercury, (*b*) solid sliver, (*c*) solid silver chloride and (*d*) solid mercurous chloride. The increase of electromotive force of the cell as one passes from high concentrations of chloride ion to low concentrations of chloride ion should be caused individually by (*a*) the increase in the effective activity of silver metal or of mercurous chloride or (*b*) the decrease of effective activity of mercury metal or silver chloride. The thermodynamic activity of the metallic components are not likely to be affected by the changes in chloride ion concentration in aqueous medium.

Let us now consider the thermodynamic activity of solid silver chloride present on the surface of the silver-silver chloride electrode. It is known[2] that even single crystals of silver chloride contain thermally produced Frenkel defects involving interstitial silver ions and the silver ion vacancies. The Schottky mechanism can also operate in producing silver ion vacancies and surface silver ions. The surface silver ions can enter into solution by hydration. Any increase in chloride ion concentration in solution would naturally affect the concentration of vacancies and interstitials in solid silver chloride particles, not only at the solid-aqueous interface but also in the bulk of the particles in view of the mobile nature of the imperfections. This is particularly possible since the interstitials in solid silver chloride are known to have high mobility.[3] This would naturally change the thermodynamic properties of the silver chloride particles. In fact, we may even consider that the crystal would get completely modified into a form having different lattice energy, when it is brought into contact with solution.

In a sense this has indeed been suspected to happen under certain conditions, for example, the passivating film on iron formed by interaction with nitric acid is supposed to be a special oxide not corresponding to any of the known oxides of iron in bulk form. In fact, the solid state effects are shown to play a very important

part in passivation phenomena.[4] Furthermore, modification of properties of solids by doping from solutions of impurities is often resorted to in solid state work.

The possible effect of chloride ions in solution on the properties of the film gets support from an observation made in this laboratory. A silver chloride film was prepared by anodizing a silver foil in 2 M hydrochloric acid at a current density of 10 mA/cm.[2] for one hour. The film formed under these conditions could be easily detached from the foil. The surface which was in contact with metal during formation had a dark grey colour presumably due to a high concentration of interstitial silver ions and corresponding electrons and exhibited high conduction. On keeping it under aqueous saturated solution of potassium chloride, the colour changed to a pale grey. The diffuse reflection as measured by means of Beckman Spectrophotometer gave a value of 8% for the original film and 12·5% for the treated film. This confirms the removal of interstitial silver ions by interaction with a high concentration of aqueous chloride ions. The corresponding electrons presumably also got removed by an appropriate interaction. With dilute solution of KCl (0·1 M) there was no perceptible change in colour. It may be mentioned incidentally that a complete modification of the thermodynamic properties of a solid phase by a constituent in solution, is easiest if the solid phase is in the form of a thin film. The conditions of experimentation by Constantinescu appear to be, therefore, particularly advantageous to get this effect in a marked way. It may be of interest to mention in this connection the observation made by Bates *et al.*[5] as a result

aqueous solution. The individual magnitudes of the effects (of chloride ion concentration in the aqueous solution) on the thermodynamic activity of solid mercurous and silver chlorides would be different. It is this differential effect that causes the variation of the electromotive force of the cell under discussion.

SOLID STATE EFFECTS AND REVERSIBILITY

With reference to these solid state effects, it is of interest to examine the question of reversibility. The high reversibility exhibited by the silver-silver chloride electrode has eluded any plausible explanation. It is assumed that the electromotive equilibrium is between the silver metal and the aqueous silver ions in the saturated solution of silver chloride. The concentration of silver ions in a saturated solution of silver chloride in 0·1 M KCl would be of the order of 10^{-9} M. Assuming that the whole of the metal surface is in contact with the solution, it would require a current density as low as $2·5 \times 10^{11}$ amp./cm.[2] to completely upset the concentration of silver ions near the electrode and thence the potential of the electrode. The silver/silver chloride electrode however can bear current densities higher than the above by several orders. In order to understand this, it would be necessary to postulate that exhaustion or build up of silver ion concentration is prevented by fast dissolution and precipitation processes combined with fast transport of the silver ions in aqueous solution from the silver chloride surface to the metal surface.

Whereas it is not impossible to make arbitrary postulates which favour a good reversibility by the above mechanism, it appears desirable to examine an alternative picture of reversibility based on solid state interactions, as follows:

Ag (metal lattice)	= Ag⁺ (interstitial in silver chloride)	+ e⁻ (in metal)	(2)
Ag⁺ (interstitial in silver chloride)	+ Vacancy (of Ag⁺ in solid AgCl)	= Ag⁺ (in lattice of solid silver chloride)	(3)
Ag⁺ (in lattice in solid AgCl)	= Ag⁺ (surface)	+ Vacancy (in AgCl solid)	(4)
Ag⁺ (surface)	+ Water or Cl⁻	= Ag⁺ (aq. or chlorocomplex)	(5)
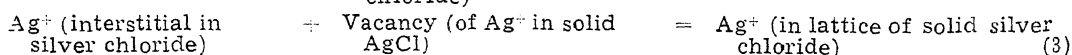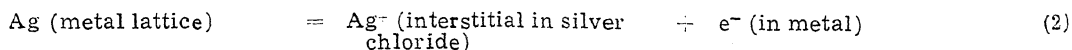
of extremely careful experimentation, with regard to the reproducibility of silver/silver chloride reference electrodes: "The most extensive and careful measurements of e.m.f. of cells H₂,Pt/HCl/AgCl/Ag have indicated that the observed differences in E° values are to be attributed to small differences in the structure of solid phases since the uncertainty of activity of ·0005 HCl at 0·01 M. is only 0·03 mV."

A similar change in thermodynamic activity of mercurous chloride can be expected with change in the concentration of chloride ion in

The high reversibility of the system implies that all these consecutive steps have a high exchange rate. The very high Faradaic capacity[6] reported for Ag/AgCl KCl electrode (400 microfarads per square centimetre) appears again to indicate the high exchange rate.

With silver chloride crystals in contact with silver metal on one side and aqueous solution on the other, there would be a high concentration of interstitials near the metal and the corresponding electrons would exhibit high electronic conduction. The portion of the silver

chloride film away from the metal would show mainly ionic conduction. In the intermediate region there would be extensive interlacing of electronic conduction and ionic conduction. The effect would be equivalent to a very large interface between the electronically conducting and ionically conducting regions and appears to play a most important role in causing reversibility.

With regard to step 5 of the mechanism, namely the interaction between silver chloride solid and the aqueous solution, it is likely that there is a strong exchange of chloride ions between the surface of silver chloride solid and the solution, which in turn causes exchange in the other steps in succession, *viz.*, steps 4, 3, 2 and 1. This would naturally make the degree of reversibility a function of concentration of chloride ions.

One can also see from the above mechanism the possible main factor which would bring about a lowering of reversibility. The lowering would be caused by the occurrence of a barrier for the exchange in any of the consecutive interactions (*vide* equations 2-5). The main probable barrier is a thick stoichiometric layer of silver chloride which would bring down the ionic and electronic transport in the solid. In this connection, it is pertinent to note that electrodes with white silver chloride (obviously free from interstitials) show poor reversibility whereas those with violet silver chloride show good reversibility.[7] It is also known, a long contact between metal and the halide is necessary before proper behaviour can be obtained.[8] Long intervals of time, of the order of hours and days, are inexplicable in terms of liquid phase diffusion and are presumably connected with the development of stoichiometric barriers. In this connection it is of interest to note that it is usual to give a heat treatment to silver chloride at 350° C. for getting a product showing good electromotive behaviour.[9] It is known that the fractional concentration of interstitials in such a product may be as high as 10^{-3}. It is again of interest to note that the concentration of interstitials in the electrolytically prepared silver chloride at a current density of 1 mA per cm.^{2} (which is recommended for preparation of reversible electrodes) is of the same order. All the successful efforts made at getting highly reversible electrodes appear to result in making this barrier as thin as possible.

The Calomel Electrode

What is discussed above is also true to a large extent with reference to the calomel electrode. For instance, the capacity of the calomel electrode is known[10] to be as high as 1000 uF/cm.^{2} Janz

and Ives[11] have shown this untenability of the classical mechanism to explain the high reversibility. To quote Janz and Ives, to explain the degree of reversibility it is necessary that "the duty of depolarising about 35 square metres of mercury surface devolve upon each mercurous ion. This is ridiculous........." Furthermore, Hills and Ives[12] by their careful observations have demonstrated the presence of intense solid state interaction between white mercurous chloride and liquid mercury and its consequential "dramatic" effect on electrode reversibility. The product has a grey colour, similar to that of the electrolytic product.[13] The "highly reactive intermediate" they have rightly postulated to explain this interesting behaviour is obviously connected with the formation of interlacing electronic and ionic conducting regions within the crystals, leading to a remarkable reversibility. The importance of grinding in the dry state[14] can be appreciated from the fact that the solid state interaction between mercury and calomel would be hindered by the hydration layers on calomel and on mercury.

Conclusion

It is thus seen that solid state effects play an important role in determining reproducibility and reversibility of the electrodes of the second kind. The extension of these ideas is likely to explain many other mysterious behaviours of these electrodes and would help in designing conditions under which most reproducible and reversible electrodes can be produced.

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LETTERS TO THE EDITOR

RADIOWAVE FADING AT WALTAIR DURING I.G.Y.

Fading analysis of the ionospheric drift records taken during the International Geophysical Year (I.G.Y.) at Waltair (17° 43' N; 83° 18' E; Geo. Mag. Lat. 7·4° N.) was carried out and the results have been reported earlier (Rao and Rao). Further results obtained are presented in this communication. Following the method given by Rice[2] the fading frequency is calculated in cycles per minute by counting the number of peaks per minute in a fading record. About 350 records taken on 2·3 Mc./sec. in the E region and 300 records taken on 5·6 Mc./sec. in the F_2 region during magnetically quiet days were analysed.

With a view to study the difference in fading frequency during daytime and night time, all the fading frequency data taken on 2·3 Mc./sec. was separated into daytime (0700–1800 hours) and night time (1900–0600 hours) data. Night time records were taken on E_s reflections. The average fading frequency in the E region during daytime and night time was found to be 10·96 and 14·02 cycles/minute respectively. The observed increase in the fading frequency during night time is in conformity with the result of Millman,[3] who arrived at a similar conclusion from a study of fading data taken on a frequency of 150 Kc./sec. The observed increase in the fading frequency during night time may partly be due to the ionisation produced by meteors in the upper layers of earth's atmosphere. It would be worthwhile here to quote Rao and Rao[4] who reported positive correlation between meteor activity and E region fading. It has already been reported that at Waltair drift speed is greater during night compared to daytime (Rao and Rao).[5] Part of the increase in fading frequency can therefore be attributed to the larger drift speeds observed during night time. A similar analysis in the case of F_2 region reflections taken on 5·6 Mc./sec. was carried out and the average fading frequency during night time and daytime came out to be 11·22 and 8·37 cycles/minute respectively. The observed increase in the night time value of the fading frequency may be due to the presence of spread echoes at night time in the F region levels, which is more frequent at Waltair during I.G.Y.

Rao and Rao[1] from a study of the diurnal variation curves of fading frequency and drift speed in the E region at Waltair and Yamagawa concluded that the diurnal variation of fading frequency may be used as a fairly good index of the diurnal variation of drift speed. In order to test whether this is true in the case of F_2 region, the values of fading frequency available at intervals of one hour are averaged and these values are plotted against local mean time (LMT) (Fig. 1). The values of drift speed
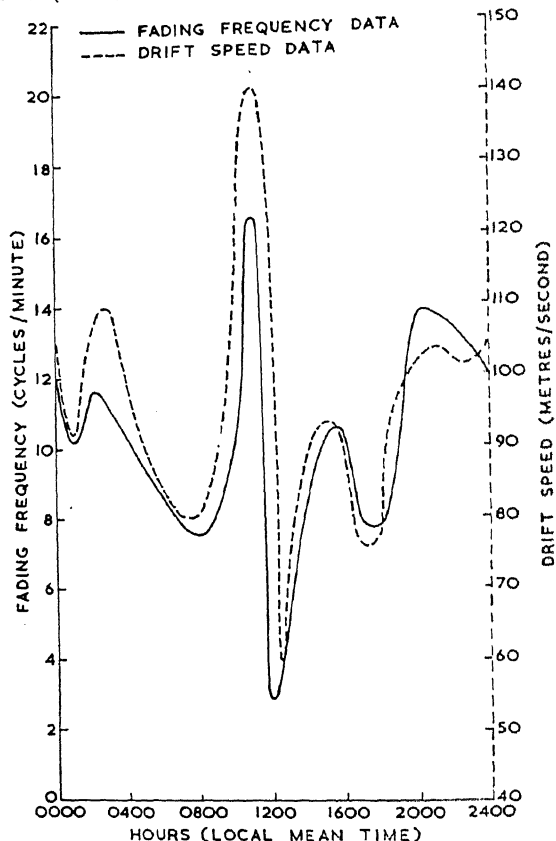
FIG. 1. Diurnal variation of fading frequency and drift speed in the F_2 region.

(calculated by the 'Similar fades method' due to Mitra)[6] available at interval of one hour are averaged and the average values are plotted against local mean time in the same figure. It will be interesting to note that these two diurnal variation curves are remarkably similar. In order to establish the extent of similarity statistically, standard statistical methods were used and the correlation coefficient

came out to be 0.84 ($P = 0.01$ level). From this highly significant correlation, we can definitely conclude that the diurnal variation of fading frequency can be taken as a fairly good index of the diurnal variation of drift speed. As the fading frequency measurement can be made by a very simple technique, this offers a possible method of studying the mean diurnal variation of drift speed without having recourse to elaborate experimental techniques required for drift measurements.

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Ionosphere Research   P. S. KESAVA RAO.
  Laboratories,   B. RAMACHANDRA RAO.
Physics Department,
Andhra University, Waltair, *January* 27, 1967.

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AMMONIUM THIOCYANATE AS A GRAVIMETRIC REAGENT FOR COPPER: A NEW PROCEDURE

AMMONIUM thiocyanate precipitates copper quantitatively as cuprous thiocyanate from acid solution in the presence of sulphurous acid. The copper solution should be slightly acidic with respect to hydrochloric or sulphuric acid. Sulphurous acid reduces cupric ions to cuprous state and maintains it in that state. Based on this, Kolthoff and Van Der Meene[1] described a procedure for the gravimetric determination of copper. Belcher and West[2] used ferrous salt for the reduction of copper II to copper I and obtained results as satisfactory as those with the method employing sulphurous acid as the reductant. The indicator properties of the ferric thiocyanate complex served the purpose of estimating the correct amount of thiocyanate to be added to the copper solution. Stathis[3] recommended reduction with ascorbic acid to avoid the interference of lead, bismuth and cadmium.

We have now found that ammonium thiocyanate could function both as a reductant and precipitant, in the quantitative precipitation of copper as cuprous thiocyanate, provided

the reaction is carried out in acetic acid medium instead of mineral acid. Thus there is no need at all to employ any reducing agents such as sulphurous acid, ferrous ammonium sulphate or ascorbic acid in the gravimetric estimation of copper as cuprous thiocyanate.

All chemicals employed in our investigation were of analytical reagent quality. A stock solution was prepared by dissolving a weighed amount of A.R. (B. D. H.) copper sulphate in water and then diluting to a known volume. Its strength was further determined iodometrically.

Recommended Procedure.—A known volume of the standard copper sulphate solution was pipetted out into a clean beaker (400 ml.), about 45 ml. of glacial acetic acid were next added and diluted to ca. 150 ml. The solution was then kept on a boiling water-bath for 30 minutes and a freshly prepared 10% ammonium thiocyanate solution was added dropwise with constant stirring till the formation of the precipitate was observed. About 5 ml. of water was added and the precipitation was complete. The heating was continued till the supernatant liquid became colourless. The contents of the beaker were allowed to cool to room temperature and after 2–3 hours, the precipitate was filtered through a weighed No. 4 sintered glass crucible. The precipitate was washed 4–5 times with a cold 0.1% solution of ammonium thiocyanate and finally with 20% ethanol till the precipitate was free from ammonium thiocyanate. The precipitate was dried to constant weight at 110–120° C. and weighed as cuprous thiocyanate.

The results of determination of copper by this method using varying amounts of the metal and in presence of different concentrations of the acid recorded in Tables 1 and 2 respectively show that copper could be determined accurately by this method and the acid concentration is not critical.

TABLE I

Determination of copper as cuprous thiocyanate

Copper, mg.		Error %
Taken	Found	
63.70	63.55	−0.235
95.55	95.45	−0.104
126.60	126.70	+0.089
191.10	190.90	−0.104
254.80	254.40	−0.157
318.50	318.30	−0.063

Belcher and Nutten[4] drew attention to the fact that the main source of error in solutions

TABLE II
Effect of acetic acid concentration

Acid Concentration	Copper, mg.		Error %
	Taken	Found	
2 N.	126·8	123·8	− 2·366
3 N.	126·8	127·0	− 0·157
4 N.	126·6	126·7	+ 0·089
6 N.	127·2	127·1	− 0·078
8 N.	127·2	127·1	− 0·078
10 N.	127·2	127·1	− 0·078

containing copper as the only cation is incomplete precipitation, because of too high an acidity or an insufficiency of a reducing agent. In view of this also, the procedure described above, possesses an advantage over the existing methods.

The authors wish to express their thanks to Professor K. Neelakantam for his interest in the work.

Department of Chemistry,   D. VENKATA REDDY.
Sri Venkateswara Univ.,   S. BRAHMAJI RAO.
Tirupati (A.P.), India,   N. APPALA RAJU.
November 25, 1966.

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o-PHENOLIC OXIMES AS ANALYTICAL REAGENTS FOR NIOBIUM

NIOBIUM and tantalum always occur together in nature and they replace each other isomorphously in their minerals. The detection and determination of these elements in presence of each other is therefore of considerable importance.

Cockbill[1] has reviewed the available methods for the determination of niobium and tantalum. The o-phenolic oximes do not appear to have been examined as reagents for one or both these elements. In the course of investigations on the use of organic reagents for detection and determination of these elements it was found that niobium in complex oxalate solutions gave lemon yellow precipitates soluble in dilute mineral acids, with salicylaldoxime, resacetophenone-oxime and 2-hydroxy-1-naphthaldoxime whereas tantalum under the same conditions gave only white turbidities. The sensitivities of these reactions were determined according to Feigl's method[2] and the results reported below.

TABLE I

Reagent	Identification limit	Dilution limit
Salicylaldoxime	50 γ	1 : 1,000
Resacetophenone-oxime	50 γ	1 : 1,000
2-Hydroxy-1-Naphthaldoxime	25 γ	1 : 4,000

Resacetophenone-oxime is readily prepared in a state of highest purity and is the least expensive of these three reagents. Neelakantam and Sitaraman[3] first introduced it as a reagent for the colorimetric estimation of iron and several other applications in analytical chemistry have since been reported.[4-14] It has now been examined for the gravimetric estimation of niobium in presence of traces of tantalum.

Procedure.—Niobium pentoxide supplied by the Atomic Energy Establishment, Trombay, containing not more than 250 p.p.m. of tantalum pentoxide was used.

250 mg. of the anhydrous pentoxide was accurately weighed, fused with potassium pyrosulphate in a silica crucible, the melt dissolved in saturated ammonium oxalate solution and made upto 250 ml. with water. A measured volume of this solution was precipitated with an excess of an aqueous alcoholic solution of resacetophenone-oxime (1%) and 15–20 ml. of a saturated solution of ammonium acetate whose pH was adjusted to 7·5–8·0 with ammonia (2 N.). The precipitate was digested on the water-bath for one hour and filtered hot through Whatman No. 42 paper. It was washed with a hot 1% neutral solution of ammonium chloride until the filtrate failed to give a violet colour with neutral ferric chloride (test for reagent). The precipitate with filter was dried, incinerated and ignited in a tared platinum crucible and weighed. Typical results are recorded below.

TABLE II
Niobium pentoxide

Taken (mg.)	Found (mg.)	Error (mg.)
10·0	10·1	+ 0·1
20·0	19·9	− 0·1
30·0	30·1	+ 0·1
40·0	40·3	+ 0·3
50·0	50·0	0·0

These preliminary investigations show that the recovery of niobium from oxalate solution is quite satisfactory.

The author wishes to thank Prof. K. Neelakantam for his kind interest in the work.

Dept. of Chemistry, R. Raghava Naidu.
S. V. University College,
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NATURE OF INTERFERENCE OF TRICHLOROACETIC ACID IN NELSON'S COLORIMETRIC SUGAR ESTIMATIONS

Of the several methods available for estimation of reducing sugars, Nelson-Somogyi colorimetric method using the arseno-molybdate reagent is considered one of the most sensitive, accurate and widely used one.[1] When we employed this method for the assay of amylase and cellulase activities, we found that the use of trichloroacetic acid to arrest the reaction, as is mostly done with most of other enzyme reactions, resulted in inhibition in the colour development. The present communication deals with the nature of the interference of trichloroacetic acid in sugar estimations.

3·0 ml. of solution containing glucose, varying in concentration from 25 to 150 µg. and trichloroacetic acid at required concentrations were heated along with 2·0 ml. of low-alkalinity copper reagent for 15 mts. in a vigorously boiling water-bath; after cooling for 3 mts. under tap, 2·0 ml. of arseno-moylbdate reagent was added and the volume made upto 20·0 ml. The colours developed were read against the appropriate blanks exactly after 15 mts. at 500 mµ.[1]

Inhibition of colour development by trichloroacetic acid increases with its concentration (Fig. 1); total inhibition results when trichloroacetic acid/glucose ratio exceeds 25 (Fig. 2). The inhibition seems to result from prevention of the reduction of Cu^{++} to Cu^{+} by the sugar, for, addition of trichloroacetic acid after the reduction, prior to or after addition of the arsenomolybdate reagent does not have any effect.
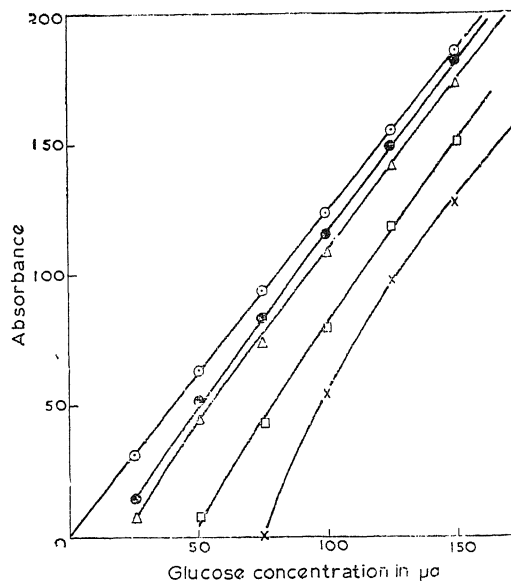
FIG. 1. Effect of trichloroacetic acid on standard graph of glucose colour. ⊙—⊙ Standard graph without trichloroacetic acid. 1. ●—● 100 µg. of trichloroacetic acid. 2. △--△ 500 µg. of trichloroacetic acid. 3. □—□ 1 mg. of trichloro acetic acid. 4. ×--× 2 mg of trichloroacetic acid.
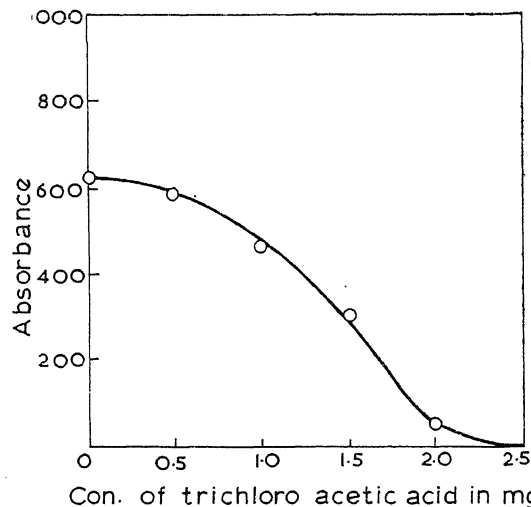
FIG. 2. Effect of trichloroacetic acid on color by 100 µg. glucose.

It has been observed that the presence of zinc or mercurous ions in deproteinized blood filtrates yielded lower amounts of colours in sugar estimations by the above method.[2] The present investigation shows presence of trichloroacetic acid, which is used for deproteinizing, causes inhibition in the colour development, the degree

of which depends on the trichloroacetic acid/reducing sugar (glucose) ratio.

Robyt and Whelan[3] have recently recommended the use of Nelson's colorimetric method for the assay of amylase activity. For the assay of cellulase, Hash and King[4] and Myers and Northcote[5] arrested the enzyme action by Somogyi's copper reagent whereas Festenstein[6] used barium hydroxide and zinc sulphate for deproteinizing. In our experiments on cellulase and amylase of *Fusarium vasinfectum*[7,8] the enzyme was stopped by heating, which method was most suitable especially when the reaction mixture has to be preserved. Hence, we recommend that trichloroacetic acid may not be used in those experiments where estimation of reducing sugars is desired.

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Univ. Biochemical   A. SAMPATHNARAYANAN.
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INCREASE IN ACTINOMYCETAL POPULATION OF STORED SOILS

CHANGES in the microbial population of soils during storage drew attention in the past primarily because of the time-lag between collection and examination of samples. Recently, however, this topic has interested many investigators because of the reported accumulation of fungistatic substances in soils stored over a long period and its consequential effect on bacterial population. In fact, the increase in actinomycetal population in such soils has been attributed to the presence of fungistatic substances. The object of this note is to report the recent observations made in this laboratory on soils which had been under close examination for nearly a decade.

Seventy-three soils, the actinomycetal content of which was assessed 9-10 years previously, were kept preserved as air-dried samples in screw-capped bottles. These were microbiologically examined recently using the same method and medium as reported in the previous survey.[1] The actinomycetal population was enumerated after plating proper dilutions of soils on Mcbeth and Scales ammonium sulphate-starch agar,[2] in duplicate, followed by incubation for 5 to 7 days at 30° C. The pH of the soil suspensions was measured on a Beckman pH meter.

The results obtained in case of six soil samples, which typify all those examined, are expressed in Table I. The samples were so

TABLE I

pH and actinomycetal content of some soils

Soil	pH		Count per g. of air-dried soil	
	Previous	Present	Previous	Present
A_{12}	3·0	3·1	14,430	21,500
A_{11}	5·2	5·3	20,140	23,500
C_9	8·8	8·7	170,100	190,000
B_{13}	5·0	5·9	332,100	340,000
A_7	8·2	8·0	481,600	495,000
A_{19}	6·8	6·8	3,047,000	4,850,000

chosen that they differed from each other considerably with respect to soil reaction and the actinomycetal populations. The general pattern was similar in all the soils. Of interest was the fact that no significant change in soil reaction was caused due to the storage and/or changes in the microbial populations confirming thus the previous observations.[2] As compared to the original counts, a general increase in the actinomycetal population was however observed in the present studies. In some cases, it was observed, this increase even accounted for the net increase in the total microflora. Statistical significance of this increase was ascertained[3] and it was noted that the observed increase (mean increase per gm. of air-dried soil, $308·409 \times 10^3 \pm 90·115 \times 10^3$) was statistically significant at a 5% level of significance and 95% confidence.

Similar finding was reported by Stotzky et al.[4] who explained it on the basis of production by actinomycetes of antibiotics antagonistic to other microbial species but permitting life and activities of actinomycetes themselves. The present observation, in general, is in conformity with several others.[5-9] Whether or not such antibiotic influences help soil actinomycetes to survive and increase during storage cannot be

concluded from the work under report, but it is true that the actinomycetes persist longer in soil and that the decreasing moisture and increasing temperature conditions in air-dried soils stimulate their growth over the bacteria. It is also possible that dead bacterial cells in stored soils markedly stimulate their growth[10] and the significance of such an increase in the population in stored soils should not be lost sight of by soil microbiologists interested in the vital statistics of soils.

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LINNAEITE FROM MOSABONI COPPER MINES, BIHAR

MOSABONI copper mines of Singhbhum District, Bihar, were visited by the author recently and a study of polished ore minerals chalcopyrite, pyrrhotite, pyrite, petlandite, violarite, millerite, and linnæite was made; the last so far not identified in these ores. This report is concerned with the characters and paragenesis of linnæite.

Linnæite is white with distinct pink colour. It is rectangular or triangular, and rarely round in shape. It shows perfect (100) cleavages. The hardness of the mineral is higher than that of chalcopyrite. It is non-pleochroic and anisotropic. When observed in oil immersion, it shows higher reflectivity, corresponds to chalcopyrite but lower reflectivity than its own observed in air. The pink colour appears prominent in oil immersion also.

The linnæite shows the following textural features and interrelation with associated minerals. Linnæite is found enclosed in chalcopyrite. It makes its appearance on the inner margins of chalcopyrite contacting wall rock.

It is being overlapped by plates or flakes of chalcopyrite.

Some linnæites show interesting association with millerite. The yellow needles of millerite which are pleochroic and anisotropic are found distributed along the cubic cleavage of linnæite. The linnæite and millerite association represents an intergrowth in between them.

Linnæite along with other sulphide ore minerals and gangue (quartz, tourmaline, magnetite and apatite) cuts and permeates into wall rocks in the form of veins whose width varies considerably. The ore minerals in part show crushing and mylonitisation.

The linnæite under report is traced to intrusive soda granite and granophyres found along the thrust zone of Singhbhum District. The high temperature liquations liberated from soda granite carry ore solutions probably first linnæite (simultaneous millerite) succeeded by chalcopyrite and other minerals.

The ore minerals replace the gneisses in the area and take advantage of the structure where pressure is released precipitating the ores. Some of the minor structural adjustments perhaps account for the mylonitisation observed in ore and gangue.

Paragenetically linnæite by its occurrence and textural features appears to be early hydrothermal. Similar paragenetic (early hydrothermal) linnæites were described by Ramdohr from EVJe, Norway, and Henderson mine, Maryland.

The author thanks the university authorities for facilities.

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THE NOMENCLATURE OF AND SOME OBSERVATIONS ON THE KHONDALITES OF THE CHOR AREA, HIMACHAL PRADESH

CERTAIN doubts were expressed by my freind Sri. S. C. Chakravarti of the Geological Survey of India (personal communication) on some aspects of the 'khondalites' reported from the Chor area by Saxena and Kanwar.[1] Similar doubts might be lurking in the mind of other readers too and hence this note was thought to be essential.

In the above paper, the graphite-sillimanite schists and gneisses were identified with the

khondalites of the Peninsular India. This identity was essentially based on the similarity of the mineralogical composition and the metamorphic grade.

The possibility of the extension of the khondalites of Eastern Ghats of Peninsular India to the sites of occurrences in Himalayas reported by Saxena and Kanwar (*op. cit.*) in spite of the commonness of some of the structural characteristics like the NE—SW trend and some other tectonic and metamorphic elements does not seem to be probable in view of the fact that the distances involved between the two are exceedingly large without any relict traces and features in between to justify any such possibility. However, it is interesting to recall here that the lesser Himalayan terrain does contain the Peninsular rocks of the northern margin of the old Gondwana continent, of both the certain and doubtful nature (Pascoe, 1963, p. 2029)[2] which have been involved in the Himalayan orogeny.

Though the mere presence of sillimanite and graphite and garnets in the schists and gneisses does not merit identification with the khondalites of Peninsular India, a name given by Walker[3] to the garnet-sillimanite-graphite schists and gneisses after the Khonds of Orissa, yet since such a mineralogical assemblage has already been named as khondalite, authors preferred to name the identical rocks occurring in the Chor area of Himachal Pradesh as khondalites in order to avoid the confusion with which the petrological nomenclature is already much plagued. This also avoids giving a 'special status' to the rock occurring at one place and a 'different status' to the similar rock occurring at another locality, quite far off. Prof. E. Wenk (verbal communication) is of the opinion that for convenience the use of the name khondalite for rocks, identical to those described by Walker (*op. cit.*) and occurring in the same granulitic environment could be continued in India. He is opposed, however, to its international adoption, firstly because 'stronalite' word had already been given by Artini and Melzi[4] in 1900 to the rocks of the same mineralogical composition occurring in type-locality Strona Valley in northernmost Italy, a fact of which Walker was unaware, and hence the word 'stronalite' has the priority, and secondly because local names should be abolished from the metamorphic nomenclature. the mineralogical terms doing better service and being generally understood. Wenk[5] has compared the khondalites of India with stronalites of Italy.

The author is of the opinion that either the term be completely dropped, and be substituted by suitable mineralogical term, as suggested by Wenk, or be extended to similar rocks occurring elsewhere in India.

With regard to the suggestion of Sri Chakravarti that such granulite facies of rocks occurring in the Chor area could possibly be explained to be an extension of the Aravalli trend (of course supported by field data) to support such an assumption, author would like to point out that the field evidences to justify such an assumption are entirely lacking.

The association of the sillimanite-graphite-schist in immediate contact with the chlorite schist could be explained only on the basis of a tectonic contact between the two as there is no evidence to show that the chlorite schist occurring in immediate contact is a product of retrogressive metamorphism resulting in conversion of biotite into chlorite and sillimanite into sericite and also the development of muscovite from potash released during the formation of chlorite. Such features as above, *i.e.*, the retrogressive metamorphism as reported by Murthy[6] from the sillimanite-bearing rocks of Vindhya Pradesh, are altogether missing.

The mineral biotite which is usually missing from the Koraput region khondalite mentioned by Sri. Chakravarti is not an uncommon constituent of some specimens from the khondalites of the Chor area. In fact in the khondalites of the Eastern Ghats small quantities of minerals biotite along with calcite and rutile usually complete the make-up of the rock (Pascoe, p. 145).[7]

In this connection it would be interesting to give here the remarks of Prof. Wenk (personal communication) who writes as under : "There are many graphite-bearing sillimanite garnet gneisses and micaschists in the lowest part of the meso-zone of the Alps alternating with common garnet-biotite-plagioclase gneisses. I would never call them 'khondalites or stronalites' as these terms should be restricted to rocks containing no *sheet-silicates* into series, the granulite facies. Otherwise the local terms loose their very last sense".

Without going much into the merits of the proposal, author would like to point out that in the case of the khondalites, the adoption of the suggestion would mean a complete revision of the literature of the khondalites and I see no reason why small quantities of sheet-silicate biotite should not figure out in the rock. Granulite facies is known to contain rocks with mica, *i.e.*, sheet silicates.

Regarding the economic significance of the khondalites of the Chor area, it can be safely said that the investigations so far have revealed neither any pockets of sillimanite segregated in sufficient quantities to give rise to workable deposit nor it is associated with any other workable deposit of any other mineral as sillimanite-bearing rocks of Khasi Hills reported by Ghosh.[8]

The author does not agree with the conclusions arrived at by Dr. Dunn[9] that the absence of biotite and other hydrous minerals suggests 'dry metamorphism' of the rock. Instead the assemblage in the Chor area represents the metamorphosed products of arenaceous argillites with low alkali and water content and rich in alumina. The mineralogical assemblage and textural characteristics are strong enough in the present case to ascribe the rock to granulite facies or sillimanite zone of regional metamorphism.

The author is thankful to Sri. S. C. Chakravarti, Superintending Geologist, Geological Survey of India, for drawing the attention to the various problems associated with the rock. Author is extremely grateful to Prof. E. Wenk of the Institute of Mineralogy and Petrography, University of Basel, Switzerland, now a Visiting Professor in the Panjab University Advanced Centre of Geology, for very useful discussions, comments and going through the manuscript.

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A REPORT ON THE REPRODUCTIVE CYCLE OF THE HOLOTHURIAN, *HOLOTHURIA SCABRA* JÄGER.

THE reproductive cycles of several echinoderms, especially those belonging to the classes Asteroidea and Echinoidea, have been studied in detail.[1] However, very little is known concerning the breeding activity and the reproductive cycle of holothurians. Further, our knowledge of the reproductive cycles and breeding seasons of tropical echinoderms is scanty and is confined to the work on the starfish, *Oreaster hedemanni*,[2,3] and the echinoid, *Stomopneustes variolaris*.[4] Therefore the common holothurian, *Holothuria scabra* occurring in large numbers near Krusadi Islands (9·5° N, 79° E) in the Gulf of Mannar region on the east coast of India was taken up for the study with special reference to its reproductive and nutritional cycles. The present account deals with its reproductive cycle. This animal forms an important item of export as 'beche de mer'.

The reproductive cycle of this animal was followed using the 'gonad index' method of Kowalski.[5] Further the four stages of maturity (immature, mature, gravid and spent) were recognised based on the microscopical examination of both fresh and sectioned permanent mounts of the reproductive tissues.

From Fig. 1 it is clear that the animal breeds
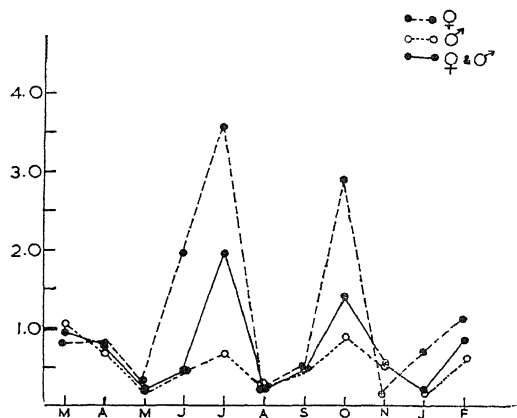
FIG. 1. Showing the gonad index of *Holothuria scabra*.

more than once in a year, *i.e.*, once in July and again in October. Of these the greater breeding activity seems to occur in July. There is a sharp rise in the 'gonad index' from June to July (1·95) after which it falls sharply in August (0·22). Again it begins to rise in September (0·47) and after reaching the maximum value (1·49) in October it reaches a low value (0·58) in November. It has been observed

that both males and females breed simultaneously, but the breeding is more intense in females than in males (Fig. 1). The biochemical changes noted in the gonad also support these findings.

Even though mature and gravid animals were found in many collections, the number of individuals at the mature and gravid states was greater during the breeding period alone. It may be suggested that the environmental conditions at that period are favourable for the breeding activity.

The environmental factor inducing breeding of animals in the temperate marine forms is generally considered to be an increase in temperature. This has been established for echinoderms[6,7] and some other invertebrates such as the scallop, *Aequipecten irradians*.[8] Apart from this other factors such as high wind in the case of the limpet, *Patella vulgaris*[9] and a decrease in temperature in the case of the chiton, *Mopalia hindsii*[10] have also been suggested. But as far as the tropical animals are concerned, it is generally thought that breeding is continuous. While looking at the results reported for a few other invertebrates, such as *Stomopneustes variolaris*,[4] *Oreaster hedemanni*,[2,3] *Penaus indicus*[11] and the clam *Meretrix casta*[12] it becomes obvious that there is a distinct breeding period in tropical waters too. Some authors are of the opinion that salinity is the inducing factor for breeding in the tropical region. Giese *et al.*[4] have pointed out that a decrease in the salinity may induce breeding in *Stomopneustes variolaris*, while Durve[12] working on the clam, *Meretrix casta* is of the opinion that neither an increase nor a decrease but an optimum salinity is responsible for the breeding of the animal.

It is known,[13] that the salinity changes in the Gulf of Mannar with the influx of waters from the Indian Ocean during the south-west monsoon and from the Bay of Bengal during the north-east monsoon. It is presumed that change in salinity may be responsible for inducing breeding in *H. scabra*. Further, rain, temperature and wind may also affect the salinity of the sea-water in that region. Hence it is thought that salinity of the sea-water may primarily act as a trigger inducing breeding in the animal. However, other factors such as increase in the concentration of the quantity of food during those periods[13] may have to be taken note of.

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Department of Zoology,   S. KRISHNASWAMY.
Madurai University,   S. KRISHNAN.
Madurai-2 (S. India),
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PRODUCTION OF CELLULOLYTIC ENZYME BY *CHOANEPHORA CUCURBITARUM*

Choanephora cucurbitarum (Berk. and Rav.) Thaxt. has been isolated from various plants and soils in India.[1-4] The author isolated this fungus for the first time from the infected shoot apices of *Crotalaria juncea* L. during August-October in 1964 and then again in 1965 from the fields of Gyanpur (U.P.). The present work deals with the production of cellulolytic enzyme (Cx) by *C. cucurbitarum*.

The fungus was grown on the following three liquid culture media in flat medicine bottles— (a) 20% decoction of fresh leaves of *Crotalaria juncea*, (b) pectin asparagine medium containing 0·5% glucose, 1·0% pectin, 0·4% asparagine, 0·05% magnesium sulphate, 0·1% potassium dihydrogen-sulphate and 0·2% yeast powder, and (c) starch medium containing 0·45% asparagine, 0·34% dibasic potassium phosphate, 0·1% magnesium sulphate, 3·0% starch and 0·1% sodium chloride. The pH of the media was brought to 7·2 and then 15 ml. of each medium was separately taken in culture bottles, sterilized by autoclaving, inoculated with spores of the fungus from one week old culture growing on PDA and then incubated at 30° C. After the required incubation period the mycelium was removed from each bottle and the filtrate separately collected. Each filtrate was then centrifuged to clear it and tested for the activity of Cx enzyme by viscometric method[5] using 1·0% carboxy-methyl cellulose (CMC). The enzyme preparation was considered to be 100% active if 1 ml. of enzyme solution reduced the

viscosity of 5 ml. of 1·0% of CMC solution to that of distilled water in 2 minutes. The results are shown in Table I.

TABLE I
Production of Cx enzyme on different media

Medium	Per cent of Cx activity after			
	2 days	3 days	4 days	5 days
Decoction medium ..	17	27	17	15
Pectin asparagine medium ..	32	34	35	28
Starch medium ..	72	82	71	28

Most active enzyme was produced by the fungus on the starch medium after 3 days of incubation period. When starch from the starch medium was replaced by other carbohydrates (w/w), it was found that though all the tested carbohydrates supported good production of Cx enzyme by the fungus, galactose gave the best results (Table II). It may be recalled here that the author in an earlier work[6] described galactose to be a very poor substitute for starch in a medium for both the growth and the production of pectic enzymes by *Pythium debaryanum*.

TABLE II
Effect of different carbohydrates on the production of Cx enzyme

Medium	% of Cx activity after 3 days
Medium with starch ..	82
Medium with glucose ..	75
Medium with fructose ..	76
Medium with galactose ..	90
Medium with mannose ..	72

The cellulolytic enzymes are supposed to be generally produced by organisms only in the presence of cellulose, derivatives of cellulose or cellobiose.[7] In only a few cases, however, production of cellulolytic enzymes in the absence of cellulose has been known, *viz.*, a few bacteria,[8] some wood rotting fungi[9] and *Rhizopus stolonifer*.[10] In the present studies it is shown that the producion of cellulolytic enzyme by *C. cucurbitarum* is not inductive like most of the organisms but seems to be of constitutive type as reported for *R. stolonifer*.[10] It is, therefore, contemplated that if more members of Phycomycetes are investigated, many more may show extracellular production of cellulolytic enzymes even in the absence of cellulose or its derivatives.

The author is grateful to Sri. V. K. Srivastava for assistance in conducting the experiments.

Department of Botany,   S. C. GUPTA.
K. N. Government College,
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A NOTE ON THE DISTRIBUTION OF SEXES IN *RHYNCHOSPORA WIGHTIANA* (NEES) STEUD.

OBSERVATIONS on the spikelets of *Rhynchospora wightiana* (Nees) Steud., collected from Dangs (*Suryanarayana* 293) and Bombay (*Shah* 445, 5050, 7548, 7749; *K.V.S.* 821) are reported here, as they are different from those given in almost all Indian floras. It is hoped that they will be taxonomically useful in future.

Under *Rhynchospora wightiana* (Nees) Steud. Clarke[1] writes "Glumes 6-7; 3 (or 4) lowest small, empty, fourth longer with perfect nut bearing flowers, upper male or rudimentary". Following him, Cooke[2] also mentions that of the 6-7 glumes, 3-4 lowest glumes empty, the next 2-sexual and larger than the lower ones, the upper male or rudimentary. According to other authors, *e.g.,* Gamble,[3] Haines[4] and Prain,[6] the bisexual flowers occur in glumes between the lowest empty ones and uppermost male or rudimentary. Further all the authors, mentioned above, have used bisexual character of the flower together with the number of styles or stigmas, which according to them are two in the genus, as a distinguishing criterion in the keys given by them.

It is difficult to identify our plant with these characters because (*i*) in no case bisexual flowers are seen, (*ii*) the style is invariably undivided, (*iii*) either fourth or fifth glume bears the female flower and fifth or sixth, the male, the latter without an abortive pistil (Figs. 1 and 2), and (*iv*) hypogynous bristles are commonly six in the female flower (Fig. 3) and 0-4 bristles in the male flower (Fig. 4).

It is thus clear that the description of the spikelet, given in Indian floras, is not correct.

Kern[5] also reports that the flowers are unisexual and the style is undivided or nearly so for *Rhynchospora wightiana* (Nees) Steud. from Malaysia. He rightly remarks, "Attention may be drawn to a mistake which has crept into literature on the distribution of sexes in at least all Malaysian members of Sect. Haplostylis *vide e.g.*, Clarke. *Illustrations of Cyperaceæ*, t. 64. Figs. 7 and 11). Even in the recent publications of Kükenthal's the flowers are described as follows: 'flos inferior hermaphroditus, superior masculus'. I nearly always find the lower flower female........".
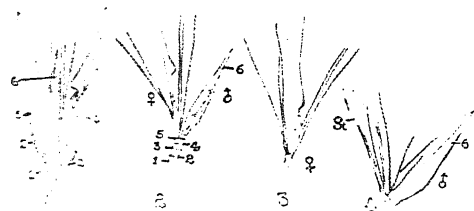
Figs. 1-4 Fig. 1. Entire spiklet. Fig. 2. Glumes removed to show position of male and female flowers. Fig. 3. Female flower. Fig. 4. Male flower, × 14.

The authors are deeply thankful to Dr. J. H. Kern. Rijksherbarium, Leiden, for critically going through our observations and for helpful suggestions. Thanks are due to Prof. P. V. Bole of St. Xavier's College for lending us the specimens from Blatter Herbarium.

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ON THE BRACHYSCLEREIDS OF *SARACA INDICA* LINN.

FOLIAR and cauline sclereids in some select angiosperms have been described in earlier papers.[1-5] Hitherto unreported brachysclereids of *Saraca indica* Linn. a member of the Leguminosae. sub-family Cæsalpinioidae. are described in this brief note. The young and old plant parts were collected from the departmental garden and fixed in form-acetic alcohol and studied with Foster's techniques.[7-8]

The brachysclereids are not found in the primary stems but occur in patches in the cortex of slightly older stems, while in still older ones they become continuous (Fig. 1 and Photos 1 and 2). They also occur in-between sclerenchymatous arcs (Photo 1) but are absent in the pith region. In the leaves, the sclereids form a sub-epidermal, discontinuous arc below the midrib extending to the first lateral vein on both the sides (Fig. 2). Sclereids may occur scattered in the leaf mesophyll and in a more or less continuous row in older leaves and stems (Figs. 3 and 4).
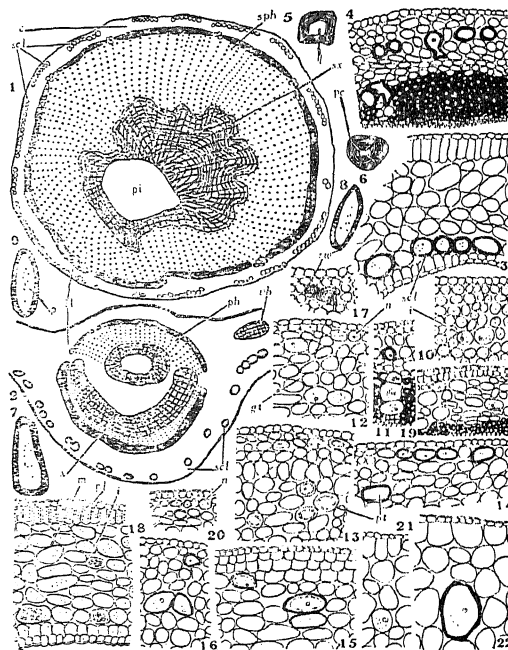
FIGS. 1-22. Figs. 1-2. Diagrammatic representations of the transections of stem and leaf respectively showing the distribution of sclereids, × 120. Figs 3-4. Transections of leaf and stem magnified respectively, × 230. Figs. 5-6. Brachysclereids from stem, × 730. Figs. 7-9. Brachysclereids from leaves, × 250. Figs. 10-17. Stages in the ontogeny of sclereids in the stem, × 230. Figs. 18-22. Stages in the ontogeny of sclereids in the leaf, × 230. (*c*, cortex ; *gt*, ground tissue ; *i*, initial ; *l*, lumen ; *m*, mesophyll ; *n*, nucleus ; *p*, pits ; *tc*, pit-canals ; *ph*, phloem ; *pi*, pith ; *pl*, palisade ; *pt*, protoplast ; *scl*, sclereid ; *sl*, sclerenchyma ; *sph*, secondary phloem ; *sw*, secondary wall ; *sx*, secondary xylem ; *vb*, vascular bundle ; *x*, xylem.)

The sclereids are generally sac-like, oval, spherical or squarish (Figs. 5-9) *brachysclereids*.[9] Leaf sclereids are slightly elongated (Figs. 7-9). They resemble vesiculose sclereids in group IV type I of Rao's[6] scheme. The adult sclereid has a very thick, lignified, lamellated, secondary wall traversed by numerous pit-canals and an empty lumen (Figs. 5 and 6).
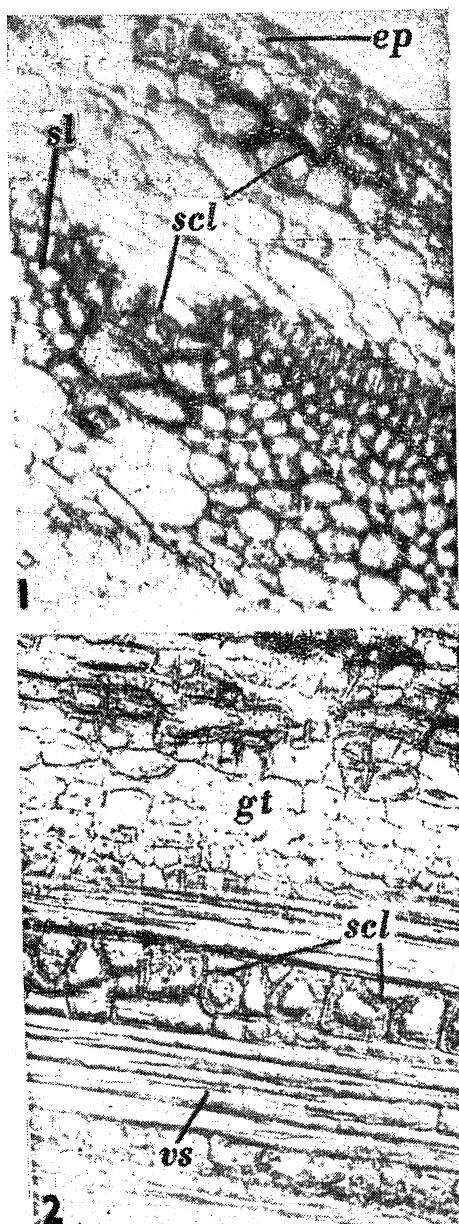
PHOTOS 1-2. Photo 1. Transection of the stem showing the sclereids, below the epidermis and in between the sclerenchyma patches, × 501. Photo 2. Longitudinal section of the stem showing a continuous row of sclereids, × 551. (*ep*, epidermis; *gt*, ground tissue; *scl*, sclereid; *sl*, sclerenchyma; *vs*, vascular supply).

Brachysclereids in the stem develop by "secondary sclerosis" of sclereid initials. Sclereid initials may be differentiated from some of the subepidermal cells, or cells between epidermis and sclerenchyma, or cells between the sclerenchymatous arcs of the cortex, all produced invariably by the activity of the interfascicular cambium (Figs. 10 and 11). A slight increase in the size of the initial followed by the deposition of the secondary wall (Figs. 12-15) and gradual degeneration of protoplasmic contents leads to sclereid formation. The nucleus may persist after the secondary wall formation (Figs. 16 and 17).

The development of the leaf sclereids is similar to those of the stem. The initials however are found next to the lower epidermis (Fig. 18) rarely in the mesophyll tissue (Fig. 18) and near to or by the side of the midrib (Figs. 19-21) and are easily recognisable by their dense and centrally concentrated cell contents. These initials are quite big in size and generally develop into sac-like sclereids (Fig. 22) in the same way as in the stem. The secondary wall of the leaf sclereids is not so thick as those of the stem sclereids. The development of sclereids is not simultaneous in the leaf and the stem.

In conclusion it may be stated that sclereids are absent in the primary stems, just a few in the unbranched young stems and young leaves. In the older stem, they form a more or less peripheral cylinder with the sclerenchyma, giving rigidity and strength. In the leaf, they support the midrib. These facts, particularly the sclereid development in the cortex of the stem, support Haberlandt's[10] contention that they serve to repair the broken mechanical tissue cylinder and add to its strength. An interesting feature is that sclereids found in all the organs of *Saraca indica* are exclusively of the brachysclereid type and have a characteristic distribution.

Dept. of Botany,   (MISS) MANJU MALAVIYA.
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POLYSETY IN *PHYSCOMITRIUM CYATHICARPUM* MITT.

NORMALLY one sporophyte develops from an archegonial head in mosses. Instances of the production of two or more sporophytes are also on record. If the sporophytes develop from different archegonia this phenomenon is termed polysety, and if they originate from one archegonium it is known as syncarpy.[1,2]

During a collection of fruiting *Physcomitrium cyathicarpum* around the University campus, about 3% plants were observed to have two sporophytes each (Fig. 1 A). A perusal of the literature revealed that such a feature has not been reported in this genus. Further study was therefore undertaken and the results are embodied in this communication.

TABLE I

Weight and diameter of capsules, number and size of spores in monosetous and polysetous plants of Physcomitrium cyathicarpum

Plants	Fresh/dry weight of (10 mature capsules) (mg.)	Capsule diameter (mean of 20) (μ)	No. of spores per capsule (mean of 20)	Spore diameter (mean of 400) (μ)
Monosetous	6·0/4·2	886	23999	31
Polysetous	2·6/1·0	708	11832	24

Lowry[3] considers that polysety is presumably a genetically controlled character and such plants must be mutants. Lacey[4] suggests that high rainfall might be responsible for polysety.
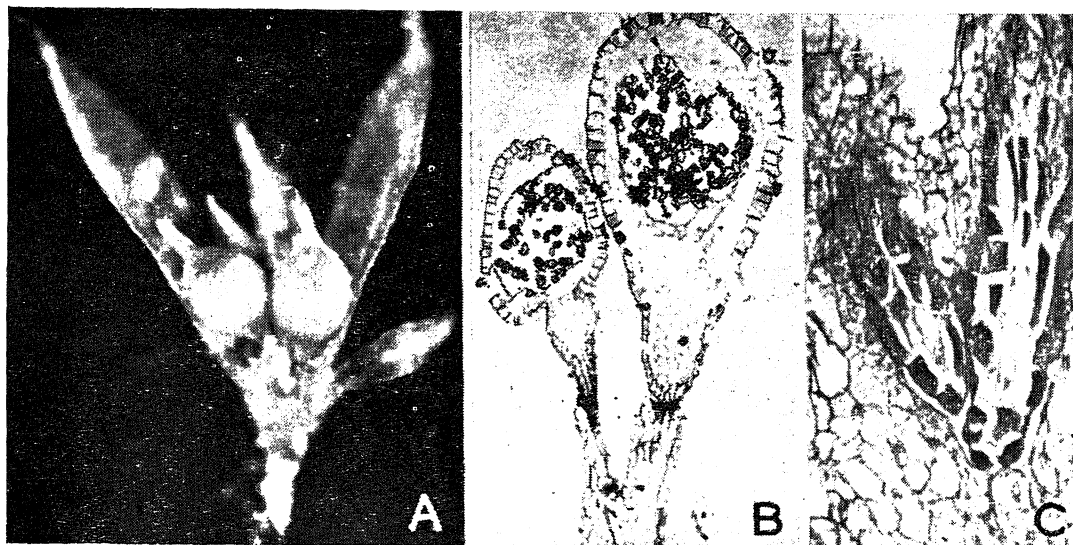
FIG. 1. A–C. Polysety in *Physcomitrium cyathicarpum*.. A. Polysetous plant, × 17. B. L.s. unequal capsules, × 41. C. L.s. lower portion of the same, × 125.

The members of a pair of capsules may be equal or unequal (Fig. 1 B), but are smaller than those borne singly. The presence of individual calyptra and foot (Fig. 1 A, C) indicates their origin from different archegonia. Spores in the polysetous plants are viable, but quite a few of them are collapsed.

The capsules from polysetous plants weigh considerably less than those from the monosetous ones. There is no strict correlation between the size of the capsule and the number of spores produced, but the diameters of the capsule and the spores are proportional (*see* Table I).

Chopra and Sharma[5] found that the species producing more than one sporogonium per head are polyploids. The widespread occurrence of this phenomenon in different families[1] indicates that polysety results when more than one embryo survives the competition for food. Since the available resources are shared by more than one sporophyte, there is a reduction in the weight and size of capsules, as well as in the number of spores per capsule. The diameter and viability of the spores may also be affected.

Department of Botany,   R. N. Chopra.
University of Delhi,   A. Rashid.
Delhi-7, *August* 22, 1966.

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* Not seen in original.

INFLUENCE OF SODIUM CARBONATE ON THE UPTAKE OF P³² BY GROUNDNUT PLANTS

Phosphorus is one of the essential elements required by plants. Under conditions of soil salinity or alkalinity, essential nutrients like phosphates (PO_4) are in so insoluble a form that they become low in availability to the plant (Russell, 1950).[1] In saline and alkali soils, among cations and anions the following are usually present: Na^{++}, Ca^{++}, Mg^{++}, and Cl^-, SO_4^{--}, and CO_3^-. In alkali soils sodium predominates in the soil exchange complex and presence of anions like CO_3^{--}, increases the pH of the soil medium.

Loughman and Scott Russell (1957)[2] studied the absorption and utilisation of P by young barley plants. Within a short period of (one minute) P³² uptake, significant proportion of

the soil only once to give a final concentration of 0·2% on dry weight basis. The plants grown under control and treatment received tap water to the field capacity. Seven days after the treatment of Na_2CO_3 plants were removed carefully from the soil. The treated plants and controls were subsequently transferred to suitable sized specimen tubes containing P³² (activity 4·6 μc./0·1 ml. $NaH_2P^{32}O_4$ solution) in 5 ml. distilled water and kept for one hour. Later the plants were removed and quickly rinsed in radioactive-free phosphate solution to remove any labelled material adhering to the surface of the roots. The plants were ground in cold 1N perchloric acid and homogenised following the procedure of Loughman and Martin (1957);[3] and centrifuged. The residue was again treated with 1N PCA and centrifuged. Both supernatants were combined and taken as the acid-soluble P fraction.

In the present study only two fractions were studied, the acid-soluble P and acid-insoluble P. An aliquot of the acid-soluble fraction was further separated into organic P(Po) and inorganic P(Pi) fractions following the method given by Richards and Rees (1962).[4] The uptake of P³² was measured as CPM with an end window G.M. tube. The activity was measured following standard radioactive techniques (Grafton D. Chase, 1959).[5]

The results are given in the following table.

Table I

P³² uptake by Na_2CO_3 treated groundnut plants

(Mean of the three replications)

		Acid-Soluble P			Acid-Insoluble P	Total P
		Organic (PO)	Inorganic (Pi)	Total		
Control	..	65·13±7·25	1·01±0·01	75·94±5·15	23·28±3·30	100
Treated 0·2% Na_2CO_3	..	62·77±3·68	0·85±0·04	78·15±6·92	28·86±7·47	100
Per cent on control	..	44·86	53·48	46·79	46·67	50·78

the absorbed P was found as organic P. They found that incorporation into nucleotides was particularly rapid. The present study was undertaken to find the influence of 0·2% sodium carbonate on the uptake of P supplied to the root medium as $NaH_2P^{32}O_4$ by groundnut plants.

Groundnut plants (variety: TMV-2) were raised in soil cultures (soil: compost, 3 : 1) in seed pans. Fifteen-day old plants were given treatment by adding Na_2CO_3 solution to

The per cent. of P³² incorporated into acid-soluble (Po and Pi) and acid-insoluble fraction on total P taken up was not apparently affected due to treatment. The results also indicate a low value of Pi and high Po incorporation in control and treated plants, possibly suggesting a rapid esterification of inorganic phosphate. The total incorporation of P³² in the treated plants when expressed as per cent. on control, was reduced to 50·78%. The acid-soluble and acid-insoluble fractions were affected almost to

the same extent. Among the subfractions of acid-soluble P, Po was more affected than Pi.

These results indicate that three-week old plants which suffered from salt injury for a week, could not absorb P to the same extent as controls even when it is made available under normal conditions. The present study shows that phosphate metabolism is affected due to salt injury.

We thank Prof. I. M. Rao for his valuable advice and encouragement.

Department of Botany,   M. SANJIVA REDDY.
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VARIEGATED MUTANT IN HEXAPLOID WHEAT

A MUTANT showing white streaks in the stem, leaves and ears was isolated in the year 1963 in the progeny of *T. œstivum* var. N.P. 868 ($2n = 42$) which was subjected to chronic irradiation with gamma rays. The total dosage given was $10 \cdot 7$ Kr. spread over a period of 2 months. When originally isolated the mutant was variegated with white streaks throughout the plant body (Fig. 1). The streaks extended from leaves to the spikelets. The plant was showing a high degree of seed sterility.

When variegated plants were self-pollinated they segregated into variegated, albino and normal green plants. Two other lines which were isolated for variegated character from acute irradiated material also segregated. The frequency of different types is given below :—

Mutants	Albino	Straita	Green
1. 1080 Cr$_1$	248	54	28
2. 1080 A$_1$	11	—	44
3. 1090 C$_1$	—	76	43

The ratios do not fit to any particular ratio. Further, variegated or albino plants appeared in the progeny only if variegated plants were self-pollinated and not in green plants. Hence the variegated leaf pattern seems to be maternally inherited as observed by previous investi-

gators.[2,5,6] It appears to be a case of plastid mutation. Variegation could be the result of a sorting out process involving two distinct kinds of plastids (yellow or green), as had been proposed by Pao and Li.[6] White and green regions on the variegated leaves were clearly defined, no areas of intermediate tissue were observed. Sorting out of the plastids resulted in some leaves being entirely green, some all white and some variegated. True breeding variegated lines could not be established. Similar instances have been reported by Correns[3] in *Mirabilis*, Baur in *Antirrhinum* and Gregory[4] in *Primula* in natural populations.

FIG. 1. Mutant plant showing variegation throughout the plant body.

I thank Dr. M. S. Swaminathan, Director, for his interest in the studies.

Botany Division,   J. V. GOUD.
Ind. Agri. Res. Inst.,
New Delhi-12, *August 24, 1966.*

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MUROGENELLA TERROPHILA FROM RHIZOSPHERE OF PADDY

RECENTLY Goos and Morris (1965)[1] have isolated a new dematiaceous fungus from a garden soil of Great Falls, Virginia and described the same as *Murogenella terrophila*. While studying the seed-borne and rhizosphere mycoflora of paddy (*Oryza sativa* L.) the authors have isolated *M. terrophila* from the rhizosphere and also from the rhizoplane of paddy during May, 1965 and March and April, 1966. The present fungus forms a new record for India and, therefore, is described below.

conidia murogenous, borne singly, smooth, brown, upto 7-septate, oval to elliptical, slightly pointed at the apical ends, $50 \cdot 0$–$64 \cdot 5 \times 14 \cdot 0$–$18 \cdot 0 \mu$.

The present isolate differs from the one described by Goos and Morris in having wider mycelium, longer conidiophores and conidia.

The culture is deposited in Mycology and Plant Pathology Laboratory, Osmania University, Hyderabad (OUF-17).
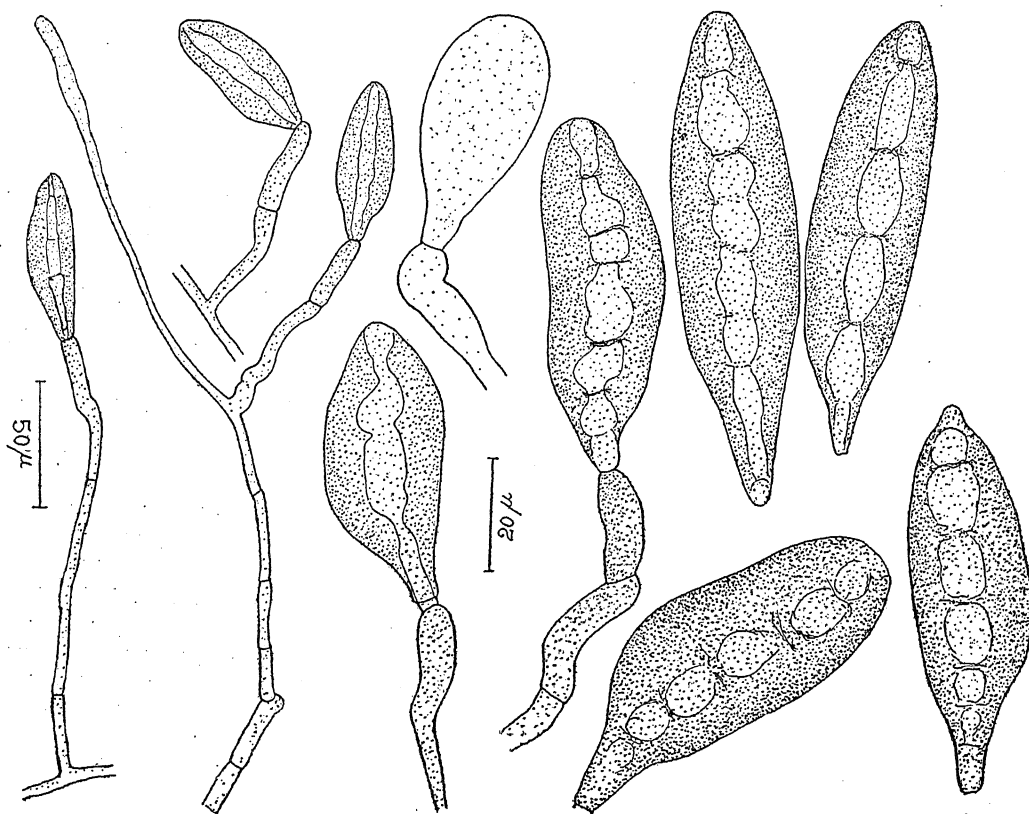
FIG. 1. *Murogene terrophila* conidiophores and conidia.

Murogenella terrophila GOOS AND MORRIS

Colonies of the fungus growing rapidly on potato sucrose agar, up to 4 cm. in diameter in 3 days, olive green with white opposed margin. Vegetative hyphæ branched, septate, hyaline to subhyaline, smooth, $2 \cdot 5$–$6 \cdot 5 \mu$ wide. Conidiophores terminal or lateral, simple or branched, septate, $39 \cdot 0$–$160 \cdot 0 \mu$ long, $4 \cdot 0$–$6 \cdot 5 \mu$ in diameter ;

Botany Dept.,   B. K. VAIDEHI.
Osmania Univ.,   A. V. LAKSHMINARASIMHAM.
Hyderabad-7,   P. RAMA RAO.
July 25, 1966.

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REVIEWS AND NOTICES OF BOOKS

The Structure of Glass. Edited by E. A. Porai-Koshits. Translated from Russian by E. Boris Uvarov. (Consultants Bureau, New York), 1966.
Volume 6. *Properties, Structure, and Physical-Chemical Effects.* Pp. xii + 230. Price $ 25.00.
Volume 7. *Methods of Studying the Structure of Glass.* Pp. ix + 245. Price $ 25.00.

The two volumes represent the Proceedings of the Fourth All-Union Conference on the Glassy State, held at Leningrad, USSR, from March 16 to 21, 1964.

Volume 6 contains fifty-three papers on advances in the study of the structure and properties of glassy materials and advanced research on the physical chemistry of oxygen-containing and oxygen-free glasses.

A few of the important topics covered are boric anhydride and borate glasses; lattice dynamics; networks in glass; oxides of the rare elements as additives; silicate, borosilicate, and polymer glasses; viscosity, annealing processes, the refractive index, and high-pressure effects in glass. Papers on oxygen-containing glasses deal with lithium silicate, sodium borosilicate, and phosphate glasses, their elasticity and density, and phenomena of phase separation, micro-heterogeneous structure, and oriented structure. Also included are papers on arsenic trisulfide, oxychalcogenide glasses, and fluoroberyllate glasses. Thermoplastic and mechanical properties of glass, and the strength of fibers of borate, cadmium, and lead glasses are discussed.

Volume 7 contains sixty-two papers describing the optical, electrical, and crystallization techniques used to probe the structure of glass.

Optical techniques covered include not only infra-red and ultra-violet spectroscopy, but also microwave spectroscopy, nuclear magnetic resonance, electron paramagnetic resonance, and, in studies of glasses containing neodymium and other rare-earth ions, combinations of absorption spectroscopy, luminescence, and stimulated emission. Electrical conductivity, injection currents, and photoconductivity methods are described as they are used to study glasses containing sodium, lithium, germanium, iron, selenium, and cadmium. Many papers concentrate on the study of the transformation from the glassy to the crystalline state, providing valuable information about glass structure. Metal ion catalysts for the trans-formation, particularly titanium, are discussed. Techniques employed in these studies include electron microscopy and etching by ion-bombardment. C. V. R.

Advances in Chromatography (Vol. 3). Edited by J. Calvin Giddings and Roy A. Keller. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1966. Pp. xiii + 271. Price $ 11.50.

The subject-matter in this volume is dealt with under two parts, *viz.,* I. General Chromatography and II. Gas Chromatography.

Part I contains the following articles: The Occurrence and Significance of Isotope Fractionation during Analytical Separations of Large Molecules, by Peter D. Klein; Adsorption Chromatography, by C. H. Giles and I. A. Easton; The History of Thin-Layer Chromatography, by N. Pelick, H. R. Bolliger, and H. K. Mangold; and Chromatography as a Natural Process in Geology, by Arthur S. Ritchie.

Part II contains the following articles: The Chromatographic Support, by D. M. Ottenstein; Electrolytic Conductivity Detection in Gas Chromatography, by Dale M. Coulson; and Preparative-Scale Gas Chromatography, G. W. A. Rijnders. C. V. R.

Matrices and Linear Transformations. By Professor Charles G. Cullen. (Addison Wesley Publishing Co., Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. 227. Price $ 6.75.

The titles of the chapters contained in this book are the following: 1. Matrices and Linear Systems; 2. Vector Spaces; 3. Determinants; 4. Linear Transformations; 5. Similarity: Part I; 6. Polynomials and Polynomial Matrices; 7. Similarity: Part II; 8. Matrix Analysis; and 9. Numerical Methods. C. V. R.

Homology Theory—A First Course in Algebraic Topology. By Sze-Tsen Hu. (Holden-Day, Inc., 500, Sansome Street, San Francisco), 1966. Pp. xii + 247. Price $ 12.10.

Designed for advanced undergraduates and beginning graduate students who have already had semester courses in general topology and modern algebra, this volume presents a modern but elementary approach to homology theory. Completely avoiding the tedious classical simplicial theory, the book takes the Eilenberg-

Steenrod axiomatic approach with a new uniqueness proof. Thus computation of homology groups and applications are given as direct consequences of the axioms without using the heavy machineries constructed to define homology groups.

The titles of the chapters contained in this book are as follows: I. Axioms and Uniqueness; II. Further Consequences of the Axioms; III. Computation of Homology Groups; IV. Elementary Applications; V. Cellular Homology Groups; and VI. Singular Homology Theory.   C. V. R.

Acoustics—*Design and Practice* (Vol. 1). By R. L. Suri. (Asia Publishing House), 1966. Pp. xxviii + 539. Price Rs. 50·00.

This is a comprehensive treatise written from the standpoint of the practical engineer. A study of this book will equip the reader with the essential theoretical knowledge and the practical approach so necessary for successful acoustical design.

In the present volume under review, the author deals with the following topics: General Acoustics; Speech and Hearing; Sound Absorbing Materials and Their Applications; Problems of Indoor and Outdoor Noises and their Control; Methods of Vibration and Shock Control in Machinery; Measurement of Noise, Vibration and Sound Insulation; Design and Construction of Sound-Test Chambers; and Layout of Acoustical Laboratories.

The subject has been developed and treated in a logical and progressive sequence. Numerous examples with solutions and illustrations by means of diagrams have been given. The book contains numerous photographic illustrations, diagrams and tables which will serve the designer as a guide and for ready reference.

This book will be found suitable for a curricular course in Acoustics in the fields of Architecture and Engineering.   C. V. R.

Rothamsted Experimental Station—**Report for 1965.** (From the Librarian, Rothamsted Experimental Station, Harpenden, Herts, England). Pp. 375. Price £ 1 (post free).

In the General Report prefaced to this Annual Report Dr. F. C. Bawden, Director of the Station, comments that 1965 has been a cheerless year for crops. Whereas 1964 was more favourable than most to arable farming, 1965 was near disaster, only grass did well, and that too if not required for hay. The uneven distribution of rainfall and sunshine, in time and area, was largely responsible for this. Commenting on the effect of spraying as a routine, the Director reports that trial over 4 years has shown that spraying decreased the yield of wheat on average by 2 cwt. per acre, and did not measurably affect the yield of barley. Reporting on seed inoculants, he says, we have occasionally noted benefits from inoculations with *Azotobacter*, but few crops responded consistently (tomato is one for consistency), and it has never proved possible to define the conditions in which yields were increased or to determine the cause. However, it is certainly not because of nitrogen fixation, for, unlike *Rhizobium* in legumes, *Azotobacter* fixes only trivial amounts. As to insecticides, the pyrethrines have been found to be valuable being harmless to mammals; they are effective in killing, and insects rarely seem to develop resistance against them.

The Report contains the details of the year's work in the 11 Departments of the Station, and the field reports from the experimental farms. There are two special reviews: (1) on the use of sticky traps and the relation of their catches of aphids to the spread of viruses in crops, and (2) the population dynamics and population genetics of the potato cyst-nematode *Heterodera rostochiensis* Woll. on susceptible and resistant potatoes.   A. S. G.

Laboratory Physics—Parts C and D. Berkeley Physics Laboratory. (McGraw-Hill Book Co., Inc., 330, West 42nd Street, New York-36), Pp. 120.

This is the third of the three volumes of the Berkeley Introductory Laboratory Physics. Part C provides an introduction to statistical quantum physics and details eight experiments, four primarily dealing with electrons and four with photons. Part D on atomic physics reprints some classical experiments such as G. P. Thomson's experiments on electron diffraction, the Frank-Hertz experiments, Zeeman effect experiment, and also adds some more recent references.

Fundamentals of Electricity (Vol. 1. *Basic Principles*; Vol. 2. *Alternating Current*). By R. J. Cleaver, E. J. Meeusen and R. A. Wells, Jr. (Consumers Power Company, Jackson, Michigan). (Addison Wesely Publishing Co., Inc.).

This programmed learning text on elements of practical electricity was originally prepared for use by employees of a utility concern which

provided electricity service, and was designed to assist them toward more effective job performance. In these two volumes the text has been revised and adapted for more general use by such employees as linesmen, appliance service men, electric meter men, etc., requiring elementary general knowledge of electricity.

<div align="right">A. S. G.</div>

German for Science Students. By A. H. Rosenberg-Rodgers and E. K. Horwood. (Iliffe Books Ltd., Dorset House, Stamford Street, London SE. 1). Pp. 202. Price 30 *sh.* net.

For one who is well acquainted with the English language it is not difficult to understand German for a great amount of vocabulary is common to both languages. The aim of the book under notice is to enable English-knowing science students to read scientific literature in German with the aid of a German dictionary. Fundamentals of German grammar and syntax are explained, and emphasis is given to German word forms and sentence patterns, and their relationship with English. Some golden rules are given for easy remembrance and use. It is a new approach but should prove effective for the limited and purposeful aim of the book.

<div align="right">A. S. G.</div>

Some Characteristics of Primary Periodicals in the Domain of the Physical Sciences. [ICSU Abstracting Board-17, Rue Mirabeau, Paris-16° (France)], June 1966. Pp. 68. U.S: $ 5.00.

This report is a detailed study of the main primary periodicals covering Physics all over the world. All the 1964 issues of more than 100 periodicals were studied in details. For each of these journals, information such as periodicity, number of scientific papers published, average length of papers, delay of publication, languages used, subscription rate, description of indexes published, etc., are given including statistics on the most important data and comparison of the different results.

This report is a basic tool for all people interested in problems of scientific information as well as for scientists, libraries, documentation centres, editors of journals, etc., dealing with Physics.

Pharmaceutical Chemistry (Vol. 1)—*Theory and Application.* Edited by L. G. Chatten. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1966. Pp. 504. Price $ 14.50.

This two-volume text-book on pharmaceutical chemistry is intended for use by pharmacy students in their practical training course. It has been designed to provide adequate knowledge in the theory, preparation and analysis of pharmaceutical chemicals which will stand them in good stead when they are employed by industry or government laboratory concerned with quality controlled medicinal preparations.

This is a multi-author undertaking, the contributors being teachers of experience in pharmaceutical chemistry. Thirteen authors have written the thirteen chapters in this volume. The focal point of each chapter is the presentation of the theory, and practical experiments have been carefully selected to emphasise theoretical considerations.

The following topics are covered in the first volume : Gravimetric analysis, Acid-base tritrimetry and pH, Precipitation and Complex formation, Acidimetry and alkalimetry, Non-aqueous titrations, Complexometric titrations, Alkaloids and crude drug analysis, Ion exchange, Chromatographic techniques, Analysis of oils, fats and waxes.   A. S. G.

Books Received

Research Program Effectiveness. Edited by M. C. Yovits, D. M. Gilford, R. H. Wilcox, E. Staveley and H. D. Lerner. (Gordon and Breach, New York, N.Y.), 1966. Pp. xvii + 542. Price : Professional $ 10.00 ; Reference $ 29.50.

Chemistry and Physics of Carbon. Edited by P. L. Walker, Jr. (Marcel Dekker Inc., 95, Madison Avenue, New York), 1966. Pp. xiii + 384. Price $ 14.50.

Transition Metal Chemistry (Vol. 2). Edited by R. L. Carlin. (Marcel Dekker, Inc., 95, Madison Avenue, New York), Pp. ix + 350. Price $ 14.75.

Modern Electronics—A Practical Guide for Scientists and Engineers. By Hendrik Deward, David Lazarus. (Addison wesley Publishing Co., Inc., London W. 1), 1966. Pp. ix + 358. Price $ 7.00.

SYMPOSIUM ON THE INTERNATIONAL BIOLOGICAL PROGRAMME
NEW DELHI, FEBRUARY 23-25, 1967

A SYMPOSIUM on Biological Productivity of our Lands, Lakes and Seas and Human Adaptability to changing conditions was held in New Delhi on February 23, 24 and 25, 1967, under the direction of Prof. B. R. Seshachar, Professor of Zoology, University of Delhi and Chairman of the National Committee for Biological Sciences. Forty scientists representing various disciplines from different parts of the country interested in the objectives of the International Biological Programme took part in the Symposium and presented papers. In his opening remarks, the Chairman outlined the aims and objectives of the IBP and emphasized the need for well-planned and co-ordinated research pertaining to the several aspects of Biological Productivity and Human Adaptability. In general, the papers presented provided an adequate picture of the existing trends of research on productivity in marine and freshwater and terrestrial habitats and on some aspects of human ecology.

Conservation of our natural assets, particularly the tropical rain forests, the arid and semi-arid regions, and the swamps and marshes together with their animal communities was duly emphasized by the speakers. The paucity of ecological data on various species of plants and animals brought out the urgent need for a comprehensive programme envisaged by the IBP.

Several aspects of terrestrial productivity were discussed. In order to attain higher levels of productivity on land, proper selection of plants capable of maximum utilization of solar energy was suggested. Introduction of new plants has to be done with caution in order to avoid any disturbance in the ecological balance. Exotic plants carefully introduced into otherwise barren areas could contribute to production and better utilization of land. Further, the over-exploitation of rangelands must be prevented. Suitable varieties of grasses capable of growing in areas of minimum rainfall can be introduced to increase production. To obtain optimum results from the grasslands, controlled grazing is absolutely essential.

Introduction of hybrid varieties of food crops and widespread application of fertilizers should go a long way in obtaining better yields. The role of soil fauna in relation to terrestrial productivity was emphasized.

Experimental studies conducted on insect preference/avoidance of plants could be applied in plantation techniques to protect the economically important plants by having a 'biological fence' of repellent varieties.

Discussions on freshwater productivity were mainly centred on different aspects of fish production. India ranks third in the world in the matter of total freshwater acreage, yet the production potential is very low. Better utilization of ponds and lakes could enhance fish productivity. The available facilities for training fisheries officers and other personnel could be suitably channellized to meet the needs of the IBP with minimum expenditure. Seasonal vagaries of the monsoons which reduce the breeding potential of the fish could be overcome by adopting hatchery techniques involving the use of hormones. It was recommended that cheaper synthetic hormones available in the market, whose efficacy in inducing spawning in fishes has been tested in the laboratory be profitably employed by hatcheries on a larger scale.

Biological implications of man-made impoundments should be given better attention with sufficient follow-up studies on their ecology.

The importance of unique primary producers in tropical waters was stressed. Further studies of nitrogen-fixing algæ present in both water and soil could be most valuable in supplementing the nitrogen resources.

The extensive data collected by the International Indian Ocean Expedition can form the basis for further research on productivity in marine waters. Areas of upwelling which are potential fishing grounds have been discovered. It was emphasized that oceanographic research can aid in a practical way in utilizing the resources of the sea.

Papers on human adaptability to changing conditions dealt with the following aspects: cold and heat adaptation, racial and blood group studies, and effect of consanguineous marriages on malformations.

Some aspects of use and management of biological resources were also considered. These included extraction of leaf proteins for use as food, use of radiation in food preservation, nutrition in relation to pregnancy and mass cultivation of edible fungi as sources of food.

THE CRYSTAL STRUCTURE OF DL-ORNITHINE HYDROBROMIDE*

A. R. KALYANARAMAN

Centre of Advanced Study in Physics, University of Madras, Madras-25, India

INTRODUCTION

THE investigation of the crystal structure of DL-Ornithine Hydrobromide, $NH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH\text{-}COOH.HBr$ was undertaken as a part

$$\underset{\displaystyle NH_2}{\mid}$$

of the series of structure determinations of amino-acids and related compounds in this laboratory. This is a short preliminary report on the structure which has been established in all its essential details.

EXPERIMENTAL

Good crystals of DL-Ornithine Hydrobromide were obtained by a slow evaporation of an aqueous solution of the substance. Good single crystals for X-ray studies were really difficult to obtain. The crystals were found to be short needles with the a-axis as the needle axis. Crystallographic data[1] were collected using oscillation, Weissenberg and Buerger precession photographs with CuKα radiation. The crystal belongs to the monoclinic system with four molecules of $(C_5N_2O_2H_{12}.HBr)$ in the unit cell of dimensions $a = 9.39\,\text{Å}$; $b = 7.9\,\text{Å}$; $c = 11.66\,\text{Å}$; $\beta = 109°\,50'$. The systematic absences were $0\,k\,0$, k odd absent and $h\,0\,l$, l odd absent and thus the space group was uniquely fixed as P2$_1$/c.

The three dimensional intensity data from zero to seven layers were collected along the a-axis. The intensities were collected using the multiple film technique and were estimated visually. The usual Lorentz and polarization corrections were applied and the intensities were reduced to the absolute scale by Wilson plots. No absorption corrections were made since the mean absorption factor for the crystal was small $(\mu r < 0.75)$.

STRUCTURE DETERMINATION

Initial work was started on the a-axis projection. The 'y' and 'z' co-ordinates of the heavy atom bromine were fixed from the a-axis projection Patterson. A weighted beta synthesis[2] was done for this projection and this broadly indicated the orientation of the molecule. However, it was decided to tackle the structure using the three dimensional data. After determining the third co-ordinate of the heavy

atom from the $h\,0\,l$ Patterson, a three dimensional Fourier map was computed with the bromine phases. A cut off was used in the above Fourier—namely reflections with $|F_0|/|F_c| > 4$ were omitted from the calculations.

The above map revealed all the atoms except one oxygen, which did not come up with enough strength. The position of this oxygen atom was fixed mainly from stereochemical considerations. The R-factor computed at this stage for all the 3 D reflections was found to be 27% and the data included all the unobserved reflections. Four cycles of Least squares refinement in stages reduced the R-factor to 13.5% for 1,330 reflections. The last cycle was done with the unobserved reflections having the scheme of weighting suggested by Hamilton[3] (1955). A few more cycles of refinement seem to be needed to reach the accuracy permissible by the data. The main features presented here, however, are not expected to be altered finally.

The co-ordinates of the atoms at the present stage of refinement are given in Table 1. The

TABLE I

Atom	x/a	y/b	z/c
Br (1)	0.4540	0.1279	0.1445
O (1)	0.0486	0.1312	0.1466
O (2)	0.9203	0.1310	0.2658
N (1)	0.2598	0.3354	0.3067
N (2)	0.1934	0.6768	0.5744
C (1)	0.0394	0.1551	0.2436
C (2)	0.1803	0.2159	0.3523
C (3)	0.2704	0.0635	0.4117
C (4)	0.1997	0.9538	0.4777
C (5)	0.2837	0.7933	0.5336

numbering of the various atoms is shown in Fig. 1 which also gives the projection of the molecule down the unique axis. The structure is stabilized by a system of six hydrogen bonds. The environment of the nitrogen shows that each nitrogen atom has three good neighbours to form three hydrogen bonds suggesting thereby that each nitrogen is most probably in an NH$_3^+$ configuration. This also indicates that the carbonyl group is of the form COO$^-$. However, detailed confirmation of these will become available after final refinements. The hydrogen bonding scheme is indicated in Fig. 1. Nitrogen (1) bonds with two bromines and one oxygen (3.45 Å, 3.44 Å, 2.85 Å) and Nitrogen (2) bonds with two oxygens and one

bromine (2·90 Å, 2·81 Å, 3·33 Å). In addition Nitrogen (2) has an oxygen at 3·05 Å, which is a possible hydrogen bond distance. However, this would appear to be only a non-bonded interaction, since the angle $C(5)-N(2)-O(2) = 167·6°$, which is very unfavourable for a hydrogen bond. A detailed discussion of the structure will be reported in due course.

FIG. 1. A projection of the structures down the *b*-axis.

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STYLOCHEIRON INDICUS, A NEW EUPHAUSIID (CRUSTACEA: EUPHAUSIACEA) FROM INDIAN SEAS*

E. G. SILAS** AND K. J. MATHEW
Central Marine Fisheries Research Institute

IN the material of Euphausiacea in the deep-water plankton collections made with the Indian Ocean Standard net from the Indo-Norwegian Project Research Vessel *VARUNA* off the west coast of India, we have been able to identify 22 species of seven genera and an undescribed species of the genus *Stylocheiron* Sars for which a new name *Stylocheiron indicus* sp. nov. is proposed here. A description of the new species follows.

Stylocheiron indicus SP. NOV. (FIG. 1, *a-k*)

Material.—Holotype *male*, length 11·0 mm., R. V. *VARUNA* Sta. 2138: 9° 00′ N., 75° 58′ E. on 18-3-1964, between 10·15-11·00 hours, 300 to 0 m. vertical haul; Allotype *female*, length 13·25 mm., from same sample as holotype; Paratypes are listed in Table II. The type specimens are deposited in the research collections of the Central Marine Fisheries Research Institute, Mandapam Camp.

Description.—Frontal plate produced as a short rostrum; latter declivous with a concavity dorsally, depressed at tip which is bluntly rounded (Fig. 1, *f-i*); rostrum slightly shorter in male, but not markedly as in other species of *Stylocheiron*; gastric region of carapace with a well-developed keel or crest antero-dorsally.

First segment of peduncle of first antenna with an acute spine mid-ventrally at its distal end; mid-dorsally segment wanting in spines or tooth-like structures at distal end, but a tuft of moderately elongate setæ on a slightly elevated lobe present; second and third segments of antennular peduncle of almost equal length and normal; *upper flagellum* of first antenna relatively shorter in both sexes, 7-jointed, its length not exceeding combined length of second and third peduncular segments; flagellum distally depressed, first two segments short, third to fifth segments progressively longer, sixth segment as long as third segment and seventh segment short as first segment; sensory setæ present at joints and tip of flagellum; *lower flagellum* of first antenna 7-jointed, its length slightly exceeding combined length of

second and third peduncular segments ; flagellum laterally compressed, first segment longest, basally broader, exceeding combined length of first two segments of upper flagellum ; and thickened towards base carrying usual sensory filaments ; second and third segments short and narrow ; fifth to seventh segments each of almost equal length, fourth segment being slightly shorter.

Terminal segment of peduncle of second antenna with two long spines at its distal outer margin ; squama conspicuously broad, width being about one-fourth its length ; tip of squama falling short of tip of peduncle of first antenna ; squama with a rudimentary outer terminal spine and consequently wanting in a distinct terminal lobe.

Eye bilobate, upper portion smaller and narrower than lower portion ; widest part of lower lobe 1·46 to 1·86 times that of width of upper lobe ; in adults, height of eye does not exceed 1·4 times its greatest width ; crystal cones in upper lobe numerous, 14–16 in transverse row when viewed from top ; lobes dark brown, excepting periphery and portion between lobes which are honey-coloured.

Elongate third cormopod terminating in a false chela (Fig. 1, c–d) ; short setæ present on distal half of merus and basal part of carpus ; propodus swollen, distally bearing three marginal and a lateral spine of variable lengths, middle marginal spine being longer, strong and curved ; short dactylus with five spines on outer margin and one spine on inner margin of variable lengths ; one outer marginal spine (3rd from base) longest, strong and curved, meeting similar elongate spine of propodus in opposition to form a grasping organ ; propodus may also have a few small unmodified stiff marginal setæ. Denticle on lateral margin of carapace absent. Gills highly branched.

Abdominal segments smooth dorsally ; sixth segment relatively longer in female being 2·25 to 2·53 times longer than its depth while in male it is 2·01 to 2·44 (length measured along dorsal line and depth at deepest part of segment); combined length of fourth and fifth segments greater than that of sixth segment. Endopod of uropod slightly longer than exopod, reaching to almost tip of telson ; two minute spines mid-dorsally in posterior half of telson.

Male Copulatory Organ (Fig. 1, j–k).—Inner lobe with a rudimentary spine on a small lobe along its inner margin ; spine-shaped process acutely pointed, strongly bent inwards and not longer than terminal process ; latter more or less uniformly broad, length not exceeding three

times its width ; when viewed from behind, distal third of terminal process with a concavity in which are situated five or six distinct tooth-like processes in two rows ; distal end of terminal process curved as a hood and narrows to a pointed tip ; proximal process slightly shorter than terminal process, tapering towards tip and strongly bent in its distal third (as in *S. elongatum* of Sars[1]) ; lateral process minute, pointed, hardly one-sixth length of terminal process and situated at inner base of median lobe removed from base of proximal process ; auxiliary lobe small, placed on inner lateral margin of setiferous lobe and with three or four coupling hooks.

Males are slightly smaller than females as can be seen from the measurements and body proportions of the salient characters given in Table I.

Remarks.—A perusal of the literature shows that the following 13 species referable to the genus *Stylocheiron* Sars[1] (Genotype = *S. carinatum* Sars[1]) have been described so far. They are : *S. carinatum* Sars, *S. armatum* Colosi,[2] *S. insulare* Hansen,[3] *S. affine* Hansen,[3] *S. suhmii* Sars,[1] *S. microphthalma* Hansen,[3] *S. longicorne* Sars,[1] *S. elongatum* Sars,[1] *S. maximum* Hansen,[4] *S. abbreviatum* Sars,[1] *S. robustum* Brinton,[5] *S. mastigophorum* Chun,[6] and *S. chelifer* Chun.[7] In addition to these species, Gurney[8] described the developmental stages of *Stylocheiron* spp., and Sheard[9] listed *Stylocheiron* sp. from two stations from the B.A.N.Z. Antarctic Research Expedition 1929–31.

Of the 13 species mentioned above, the last two are synonyms of earlier described species, *S. mastigophorum* part synonym of *S. suhmii* and *S. longicorne* ; and *S. chelifer* a junior synonym of *S. abbreviatum* (Hansen[6]; Tattersall[10] Boden[11]). Hansen[3] divided the genus into three groups on the basis of the armature of the propodus and dactylus of the third cormopod and on this basis the first two species in the above list will fall under one group characterised by the penultimate segment of the cormopod having only lateral setæ ; the third to the eighth species in a second group characterised by the third cormopod terminating in a false chela having no real immovable finger ; and the ninth to eleventh species in a third group in which the third cormopod terminates in a true chela with a well-developed immovable finger from the penultimate joint.

The new species *S. indicus* belongs to the second group which Hansen[3] named the "longicorne-group" which is also recognised by later workers (Sheard,[9] Boden,[11] Brinton[12]).

TABLE I

Sex	T.L.* (mm.)	6th Abdominal segment			L. of 4th and 5th abd. seg. (mm.)	Eye				Ht. of crest (mm.)	L. of eye / L. of body
		Length (mm.)	Depth (mm.)	Length/ Depth		Length (mm.)	(A) Width of upper part (mm.)	(B) Width of lower part (mm.)	B/A		
Male ..	27	22	22	22	22	14	14	14	14	19	14
	8·75–	1·36–	0·64–	2·01–	1·50–	0·99–	0·42–	0·73–	1·46–	0·06–	0·09–
	12·0	1·67	0·79	2·44	1·99	1·27	0·63	0·94	1·80	0·09	0·11
	(10·94)	(1·58)	(0·74)	(2·15)	(1·85)	(1·17)	(0·53)	(0·86)	(1·63)	(0·08)	(0·10)
Female ..	56	34	34	34	34	19	19	19	19	32	19
	8·25–	1·73–	0·–74	2·25–	1·82–	1·08–	0·52–	0·83–	1·57–	0·05–	0·09–
	13·75	2·12	0·87	2·53	2·29	1·41	0·64	1·03	1·86	0·09	0·10
	(11·30)	(1·94)	(0·81)	(2·38)	(2·07)	(1·26)	(0·55)	(0·96)	(1·73)	(0·08)	(0·10)

* The number of specimens is given first followed by the range, and the mean in parenthesis. In addition to the adults 33 immature specimens measured are 6·5 to 8·25 mm. in total length (mean = 7·49 mm.).

TABLE II

Localities of capture of Stylocheiron indicus *sp. nov.*

Sta. No.	Date	Hours	Latitude/ Longitude	Depth of haul (m.)	Depth at sta. (m.)	No. of specimens	Total length (mm.)
2138	18–3–1964	10·15–11·00	9° 00′ N., 75° 58′ E	300–0	320	M-8 F-12	11·0 –11·75 12·0 –13·5
,,	,,	,,	,,	200–0	,,	M-13 F-21	10·5 –12·0 11·75–13·75
2139	19–3–1964	12·20–12·35	9° 00′ N., 76° 08′ E	200–0	240	M-1 F-1	9·75 13·00
2143	20–3–1964	10·10–11·45	10° 00′ N- 75° 51′ E	175–0	180	M-6 F-31 IM-41	8·75–11·25 8·25–11·5 6·5 – 8·25

(M—Male; F—Female; IM—Immature)
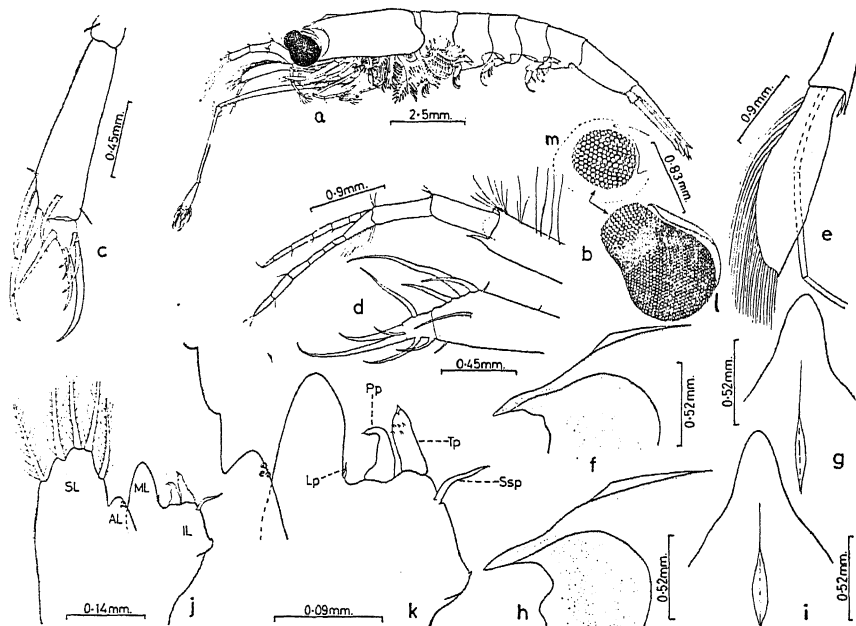
FIG. 1. *Stylocheiron indicus* sp. nov. *a*, Lateral view of female; *b*, inner view of right first antenna; *c–d*, distal end of third cormoped showing false chela; *e*, second antenna; *f–g*, rostrum of male; *h–i*, rostrum of female; *j–k*, right copulatory organ of male from behind; *l–m*, eye enlarged. (AL–Auxiliary lobe; IL–inner lobe; ML–median lobe; SL–setiferous lobe; Lp–lateral process; Pp–proximal process; Ssp–spine-shaped process; and Tp–terminal process).

3

Within this group, its affinities are decidedly towards *S. elongatum,* but it can be distinguished from it by its bilobate eye and the disposition of the crystal cones ; the nature of the rostrum ; the male copulatory organ ; and the deeper sixth abdominal segment which is shorter than the combined lengths of the 4th and 5th segments. In the combination of the following characters, *S. indicus* differs from the other five species of the "longicorne-group". The nature of the rostrum ; the presence of a well-developed antero-dorsal keel on the gastric region ; the peduncle of the first antenna stout, showing no apparent sexual dimorphism and with the basal segment wanting in spines or denticles at its upper distal end ; the broad squama of the second antenna devoid of a terminal lobe ; the terminal segment of the peduncle of the second antenna having two conspicuously elongate spines at its distal end ; in the structure of the male copulatory organ, especially the armature of the terminal process ; and in the disposition of the numerous crystal cones in the upper lobe of the eye (in adult 14–16 when viewed from top), not permitting an easy count of the transverse row of cones, as only the facets and no part of the cones are visible on all sides.

We wish to thank Dr. Edward Brinton for examining our material and confirming our identification of the new species and for his helpful suggestions ; and Mr. N. K. Prasad for help rendered in the preparation of the drawings.

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COMPOSITION OF OIL PRODUCT FROM PALLADIUM-CATALYSED ACETYLENE HYDROPOLYMERIZATION

MANAS CHANDA AND S. S. GHOSH

Chemical Engineering Department, Indian Institute of Science, Bangalore

IN the metal-catalysed reaction of acetylene with hydrogen, simple hydrogenation to ethylene and ethane is invariably accompanied by the formation of higher ($> C_2$) hydropolymers of acetylene. Several reports[1-3] are available on the reaction over palladium catalyst dealing with acetylene conversion into C_2-, C_4- and oily ($> C_4$) hydrocarbons. However, detailed composition of the oily hydropolymers of acetylene produced over palladium catalyst has not been reported in literature. The present investigation was, therefore, undertaken with that objective.

Experimental.—All the liquid products employed for the study were obtained by the hydropolymerization reaction in fluidised beds of 15·0 cm³ by volume of catalyst at a reaction temperature of 270° C. and at 60 litres per hour flow rate of acetylene-hydrogen (1 : 1 by volume) mixture. The liquid products obtained with two palladium catalysts of different additive bases, namely : Pd-SiO₂ (0·015 : 100) and Pd-ZnO-Cr₂O₃-SiO₂ (0·015 : 7·0 : 6·5 : 86·5), were fractionated in a spinning band column[4] in an atmosphere of nitrogen to exclude air from the system as the products were highly unsaturated. The boiling point and refractive index of 0·2 cm³ fractions, successively collected, were plotted against the cumulative volume (Figs. 1 and 2). A sample of raw oil was also hydrogenated with Adams' platinum catalyst[5] followed by spinning band fractionation of the hydrogenated product (Fig. 3).

Results and Discussion.—The boiling point and refractive index properties of various fractions indicate that the oil products from the reaction on palladium-catalysts consist primarily of mono-, di- and higher olefines having *even number* of carbon atoms in the molecule. Because of the multiplicity of hydrocarbons, it was difficult to isolate the individual components by the fractionation technique. On hydrogenation, however, the oil products became considerably simpler due to reduction in the number of isomers. This is reflected in the results of the spinning band fractionation shown in Fig. 3 where many individual hydrocarbons (saturated) belonging to C_6–C_8 series could be identified.

From the above observations, the presence of the following olefinic hydrocarbons in the raw

oil product is considered probable on the ground that they conform to the observed boiling point and refractive index properties[6,7] (Figs. 1 and 2). They are also reducible to any of the saturated hydrocarbons (Fig. 3) occurring in the fully hydrogenated sample. They are: hexene-1, -2 and -3, 2, 3-dimethyl butene-1, 2-ethyl butene-1, 3–methyl pentadiene–1, 2, 4-methyl pentadiene-1-2, 2–methyl pentadiene-2, 3, hexadiene-1, 3, 2-ethyl butadiene-1, 3, 2-methyl pentadiene-1, 3, hexadiene-2, 4, 4-methyl pentadiene-1, 3, 3-methyl pentadiene-1, 3, hexatriene-1, 3, 5, 2-methyl heptadiene-1, 6, octadiene-1, 5, 2, 3-dimethyl hexene-2, 3-ethyl hexene-2, octadiene-2, 6, octadiene-2, 4, 3-methyl heptadiene-2, 4, 3, 4-dimethyl hexadiene-2, 4.

The oil product obtained with simple Pd-catalyst on silica gel differs significantly from that obtained with Pd-catalyst containing the additive, $ZnO-Cr_2O_3$, inasmuch as the unsaturation in the latter is much higher. This is reflected in the higher refractive index property of its various close-boiling fractions. This fact is in accord with the earlier observation by the authors[8,9] that $ZnO-Cr_2O_3$ additive considerably cuts down the hydrogenating activity of Pd-catalyst. Thus, in the boiling range of

75°–77° C. (at atmospheric pressure of 684 mm. Hg.) the oil product from the reaction over Pd-SiO$_2$ (0·015 : 100) catalyst contains close-boiling fractions whose refractive indices (25° C.) lie between 1·4480 and 1·4500, so that the presence of 4-methyl pentadiene-1, 3, 3-methyl pentadiene-1, 3 and hexadiene-2, 4 may be inferred; whereas fractions of similar boiling range of the oil product obtained with $Pd-ZnO-Cr_2O_3-SiO_2$ (0·015 : 7·0 : 6·5 : 86·5) catalyst show refractive index values (25° C.) between 1·4600 and 1·4680. Considering this boiling point (75°–77° at 684 mm.) and refractive index (1·4600–1·4680 at 25° C), one can suggest the presence of hexatriene-1, 3, 5 for which, however, divergent values have been reported in literature,[7] thus highlighting its delicate nature. Besides hydrogenating the aforesaid fractions which, as expected, resulted in the formation of *n*-hexane, the ultra-violet absorption spectrum of this fraction was also measured with a Beckman quartz spectrophotometer (Fig. 4, No. III) in carefuly purified *n*-heptane employing concentration of 10^{-2} ml. per litre of solvent. The positions of maximum absorption
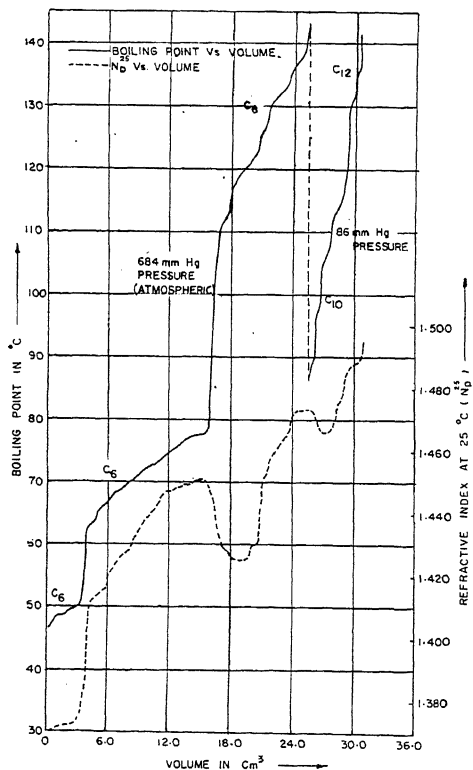
FIG. 1. Curves of the spinning band distillation of the oil product from acetylene hydropolymerization over Pd–SiO$_2$ (0·015 : 100) catalyst at 270° C.
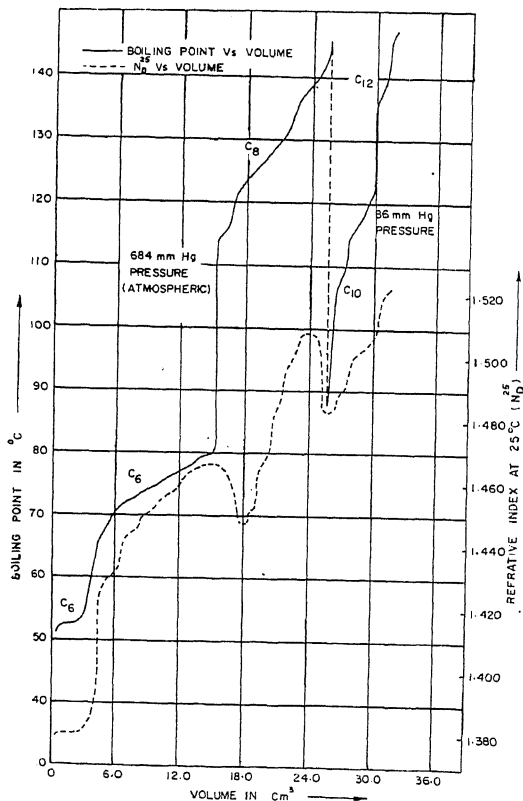
FIG. 2. Curves of the spinning band distillation of the oil product from acetylene hydropolymerization over Pd–ZnO–Cr$_2$O$_3$–SiO$_2$ (0·015 : 7·0 : 6·5 : 86·5) catalyst at 270° C.

in the resulting spectrum, *viz.*, 247 mμ, 257 mμ, and 267 mμ, agree with the reported ones[10,11] for hexatriene-1, 3, 5. The 225 mμ peak may be due to the presence of some conjugated dienes[12] and especially hexadiene-2, 4 whose boiling point falls in the aforesaid range. The 225 mμ peak is also characteristic of the other two spectra presented in Fig. 4—I for 70°–72° C. fraction and II for 75°–77° C. fraction, both from the oil product produced over Pd–SiO$_2$ (0·015 : 100) catalyst. The small peaks at 257 mμ and 267 mμ in these spectra are presumed to be due to the presence of small amounts of hexatriene-1, 3, 5, while its third peak at 247 mμ is probably overlapped by absorption due to some alien compound.

FIG. 4. Ultra-violet absorption spectra of C_6-fractions of oil from acetylene hydropolymerization over palladium catalysts. I. B.P. Range : 70–72° C. (at 684 mm. Hg press.) ; Catalyst : Pd–SiO$_2$ (0·015 : 100). II. B.P. Range : 75–77° C. (at 684 mm. Hg press.) ; Catalyst : Pd–SiO$_2$ (0·015 : 100). III. B P. range : 75–77° C. (at 684 mm. Hg press) ; Catalyst : Pd–ZnO–Cr$_2$O$_3$–SiO$_2$) (0·015 : 7·0 : 6·5 : 86·5).

evaluated from densities, are also presented in Table I.

TABLE I
Composition of oil products

Oil product	Fraction	Vol. % of oil	Density gm. /cm. (25° C.)	Wt. of oil
Produced over Pd-SiO$_2$ (0·015 : 100) catalyst Density : 0·772 gm./ cm.³ at 25° C.	C$_6$-Olefins	40·2	0·725	37·8
	C$_8$-Olefins	25·4	0·765	25·2
	C$_{10}$-Olefins	12·3	0·804	12·8
	C$_{12}$-Olefins	7·1	0·811	7·5
Produced over Pd-ZnO-Cr$_2$O$_3$- SiO$_2$ (0·015 : 7·0 : 6·5 : 86·5) catalyst Density : 0·779 gm./ cm.³ at 25° C.	C$_6$-Olefins	39·5	0·731	37·1
	C$_8$-Olefins	25·0	0·775	24·9
	C$_{10}$-Olefins	11·8	0·806	13·2
	C$_{12}$-Olefins	7·4	0·812	7·7

FIG. 3. Curves of the spinning band distillation of the fully hydrogenated sample of the oil product (C$_6$–C$_{12}$) from acetylene hydropolymerization over Pd–SiO$_2$ (0·015 : 100) catalyst at 270° C.

Table I presents the volumetric compositions in respect of C$_6$-, C$_8$-, C$_{10}$- and C$_{12}$-fractions, as determined by the spinning band fractionation (Figs. 1 and 2), along with the measured density values of the said fractions, for the oil products from C$_2$H$_2$—H$_2$ (1 : 1 by vol.) gas mixture at 270° C. over the two different catalysts with and without ZnO-Cr$_2$O$_3$ additive. The respective weight percentage compositions,

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LETTERS TO THE .EDITOR

EXTRACTION OF ZIRCONIUM FROM HYDROCHLORIC ACID SOLUTIONS BY DI-n-PENTYL SULPHOXIDE

IT has already been found in this laboratory that organic sulphoxides in solution in neutral immiscible solvents extract thorium[1,2] and uranium[3] from hydrochloric acid solutions fairly well. The present communication reports on the extraction of zirconium, an important fission product, by di-n-pentyl sulphoxide (DPSO) in carbon tetrachloride.
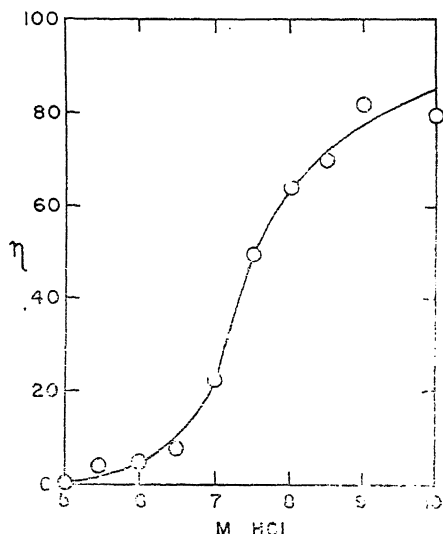
FIG. 1. The dependence of zirconium extraction on acid strength.

The chemicals used were of analytical reagent grade. Carbon tetrachloride was freshly distilled and only the fraction boiling off in a temperature range of 1° C. around the recorded boiling point was collected. DPSO was synthesized in the laboratory and was purified and characterized according to standard procedures. The initial concentration of zirconium, as zirconium oxychloride, was 0·01 M. Extraction was studied at different concentrations of hydrochloric acid between 0 and 10 M, and of DPSO between 0 and 0·5 M. For determination of the extraction coefficient, equal volumes of the two phases were shaken to equilibrium after which the phases were allowed to separate; in some cases it was necessary to centrifuge to effect rapid separation. Aliquots were estimated for zirconium iodometrically via the normal selenite.[4]

Dependence of the extraction of zirconium into 0·25 M DPSO on hydrochloric acid strength is shown in Fig. 1. It is seen that the extraction coefficient η which is small (0·035) at 4 M HCl increases in the usual sigmoid manner with increase in the acid strength to 79 (99%) at 10 M HCl. Figure 2 illustrates the variation of
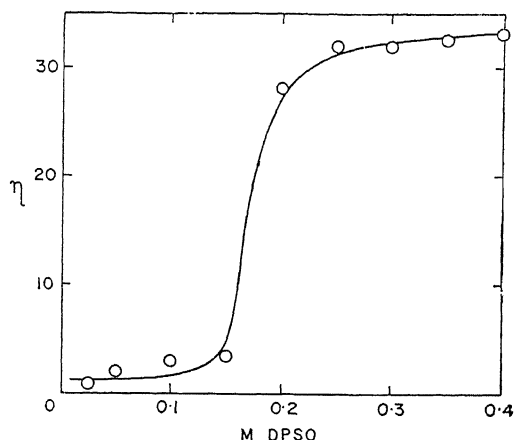
FIG. 2. The variation of zirconium extraction with DPSO concentration.

extraction from 7 M HCl with the concentration of DPSO. The extraction coefficient increases, also sigmoidally, from 0·91 for 0·025 M DPSO to 35 for 0·5 M DPSO. A comparison with the data of Levitt and Freund[5] shows that DPSO is as efficient as tri-n-butyl phosphate for the solvent extraction of zirconium.

Banaras Hindu Univ.,   S. R. MOHANTY.
Dept. of Chemistry,   (MISS) P. NALINI.
December 15, 1966.

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SYNTHESIS OF SOME SUBSTITUTED NAPHTHO (2:3-d) THIAZOLE-4:9-DIONES AS POTENTIAL FUNGICIDES

THE discovery that some of the heterocyclic quinones are useful as dyes,[1-4] catalysts[5,6] and drugs[7] led to the synthesis of several compounds with heterocyclic rings fused on the 1:4-naphthoquinone system. 2-Methyl-naphtho (2:3-d)-thiazole-4:9-dione was reported[8] to be effective against bacteria. In view of the presence of both the naphthoquinone and the potentially active thiazole rings, very good fungistatic properties may be expected for these compounds. With a view to study the structure-fungistatic activity relationship amongst naphthothiazole diones a few 2-alkyl, aryl and furyl compounds have been prepared. The parent compound of this system (I) was obtained[9,10] from 2-amino-3-mercapto-1:4-naphthoquinone by condensation with formaldehyde. Naphthothiazole diones with other substituents in the 2-position were prepared[11] by using other aldehydes such as acetaldehyde, benzaldehyde and naphthaldehyde. With dialdehydes *bis*-naphthothiazole diones were obtained.

During the present investigation, the preparation of the naphthothiazole diones has been carried out by refluxing an aqueous solution of 2-amino-3-mercapto-1:4-naphthoquinone and the aldehyde in the presence of a small amount of acetic acid. Using the appropriate aldehyde, unsubstituted (I), 2-methyl (II), 2-furyl (III), 2-phenyl (IV) and 2-substituted phenyl such as 4'-methoxyphenyl (V), 3'-nitrophenyl (VI), 2'-chlorophenyl (VII), 4'-chlorophenyl (VIII), 2':4'-dichlorophenyl (IX) and 3':4'-dichlorophenyl (X) naphthothiazole diones have been prepared. The new compounds have been analysed and the results are recorded in Table I.
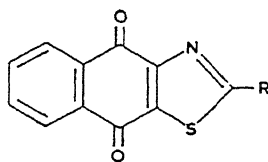
R = I. H.   II. Methyl.   III. Furyl.   IV. Phenyl.
V. 4'-Methoxyphenyl.   VI. 3'-Nitrophenyl.   VII. 2'-Chlorophenyl.   VIII. 4'-Chlorophenyl.   IX. 2':4'-Dichlorophenyl.   X. 3':4'-Dichlorophenyl.

These naphthothiazole diones on evaluation of their fungistatic activity revealed that the unsubstituted thiazole (I) is more active than the substituted ones. 2-Phenyl, 2-furyl, 2-methyl and 2-H naphthothiazoles are active in the increasing order on fungi. The results of the

fungistatic activity on *A. nigar* have been recorded in Table II.

TABLE I

Naphtho (2:3-d) thiazole-4:9-diones

Naphtho (2:3-d) thiazole-4:9-dione R =	m.p. °C	Found			Calculated		
		C	H	N	C	H	N
Furyl	270	64·0	2·7	5·1	64·1	2·5	5·0
4'-Methoxyphenyl	243	67·1	3·6	4·5	67·3	3·4	4·4
3'-Nitrophenyl	206	60·6	2·5	8·1	60·7	2·4	8·3
2'-Chlorophenyl	226	62·9	2·8	4·4	62·7	2·5	4·3
4'-Chlorophenyl	230	62·7	2·7	4·5	62·7	2·5	4·3
2':4'-Dichlorophenyl	229	56·9	2·3	3·6	56·7	2·0	3·9
3':4'-Dichlorophenyl	196	56·6	2·1	4·1	56·7	2·0	3·9

TABLE II

Fungistatic activity of the naphthothiazole diones

Naphtho (2:3-d) thiazole-4:9-dione R =	10 p.p.m. Inhibition %	100 p.p.m. Inhibition %
H	100	100
Methyl	13	87
Furyl	20	47
Phenyl	7	27
4'-Methoxyphenyl	13	33
3'-Nitrophenyl	7	13
2'-Chlorophenyl	nil	13
4'-Chlorophenyl	7	13
2':4'-Dichlorophenyl	7	20
3':4'-Dichlorophenyl	nil	13

Dept. of Chemistry,   B. HARINATH BABU.
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ESTIMATION OF DDT IN FACTORY WASTE

THE waste from the plants manufacturing DDT generally contains sulphuric acid, hydrochloric acid, chloral, chlorobenzene, chlorobenzene sulphonic acid and DDT.[1,2] In this laboratory, while analysing the waste from a factory manufacturing DDT, it was observed that none of the available methods[3] could be used directly for the estimation of DDT because of the interference caused by the organic constituents present in the waste. Chaikin[4] has suggested a method for the estimation of DDT in technical and commercial samples. It is based on the principle that DDT, when dissolved in acetic acid and heated with sulphuric acid, gives yellow colour. The colour development is rapid and quantitative. This method is also susceptible to the interference due to chlorobenzene, chlorobezene sulphonic acid and chloral, and gives high results. The feasibility of this method after a little modification, so as to overcome these interferences, was studied. The improved method and the results obtained are discussed.

A known volume of sample was extracted thoroughly four or five times, with small volumes of benzene. The benzene extracts were pooled and made up to 50 ml. A suitable volume of extract, containing not less than 0·1 mg. of DDT, was taken in a small beaker, and was evaporated to dryness at room temperature. The beaker was then kept in vigorously boiling water for 1 minute and was then cooled to room temperature. The residue was dissolved in 2 ml. of glacial acetic acid. 10 ml. of concentrated sulphuric acid was added slowly (contents of the beaker being kept stirred). The beaker was again heated in vigorously boiling water for 10 minutes and cooled to room temperature. The absorption was measured within one hour after the colour development on colorimeter at 435 mμ.

The standard curve, using pure DDT, was prepared in a similar manner. The curve between absorption and concentration of DDT obeys Beer's law between the range of 0·1 to 0·6 mg. of DDT.

Synthetic waste containing known amount of DDT and the various concentrations of the other organic components of the waste was prepared in the laboratory. The maximum concentrations of chlorobenzene sulphonic acid and chloral added in the waste were 100 mg./l. and 5000 mg./l. respectively. As the concentration of chlorobenzene in the waste was not known, saturated solution of chlorobenzene in water was

used. The amount of DDT was then estimated by the method described above. The results obtained are given in Table I.

TABLE I

Recovery of DDT from the synthetic waste prepared in laboratory

DDT added mg.	DDT recovered mg.	Percent recovery of DDT
0·218	0·215	98·6
0·25	0·245	98
0·327	0·315	96·3
0·327	0·325	99·1
0·328	0·315	96
0·375	0·365	97·3

It has already been stated that chlorobenzene, chlorobenzene sulphonic acid and chloral interfere in the DDT estimation. As chlorobenzene sulphonic acid is insoluble in benzene, only DDT, chloral, chlorobenzene and some water comes in benzene extract. It was found that the benzene extract of a sample containing chloral, chlorobenzene sulphonic acid and chlorobenzene, when treated as given in the method, does not develop yellow colour. It was observed that if the residue was not heated the results were about 18% high, but they decreased with increase in the time of heating, and when heated for about 1 minute, the recovery of DDT was nearly 100% (Fig. 1).
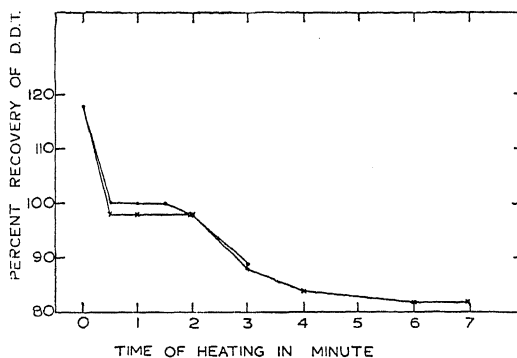
FIG. 1. Effect of heating benzene extract residue on DDT recovery.

It is clear from Table I that 96 to 99% of DDT present in the waste can be recovered and estimated by this method. The suitability of the method was further examined in the following manner. The DDT contents of the waste from a factory manufacturing it was first estimated by this method. A known amount of DDT was then added to this waste, and total amount was estimated. The results are given in Table II.

TABLE II

Recovery of DDT from the waste collected from the factory

DDT present in factory waste mg.	DDT added mg.	Total DDT estimated mg.	Percent recovery of DDT
0·140	0·174	0·315	100·3
0·205	0·174	0·383	101·1
0·210	0·174	0·383	99·7
0·230	0·174	0·400	99
0·250	0·174	0·414	97·6

These results confirm that this method can be used for the estimation of DDT in the untreated waste from the factory manufacturing it. Heating the residue of benzene extract of the sample in vigorously boiling water for 1 minute, removes the interference due to organic components present in the waste. The results obtained were usually on the lower side but the error was never more than 4%.

Central Public Health   S. K. SHRIVASTAVA.
   Engg. Research Institute,
Zonal Centre, Chandrawal Water Works,
Alipore Road, Delhi-6,
November 29, 1966.

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THE EFFECT OF ISOPRENALINE ON THE BILE SECRETION OF ANAESTHETIZED DOGS

It has been shown by several workers that adrenaline[1-3] and noradrenaline[4] diminish the secretion of bile. The biliary response to isoprenaline, which is known to be a potent β-adrenergic agent[5] does not however seem to have been investigated. The work presented here was therefore undertaken.

The experimental procedures for collection and analysis of bile are described elsewhere.[6]

Figure 1 graphically records the effect of administration of varying doses, ranging from 0·01 μg./kg. to 10 μg./kg. of isoprenaline on the rate of bile secretion. Administration of isoprenaline in all the doses first increased and then decreased the rate of bile secretion. The augmentory effect lasted for 4 minutes and the inhibitory for about 4 to 6 minutes, after which

the rate returned to normal. Increasing the dose of isoprenaline resulted in the increased augmentory as well as inhibitory response
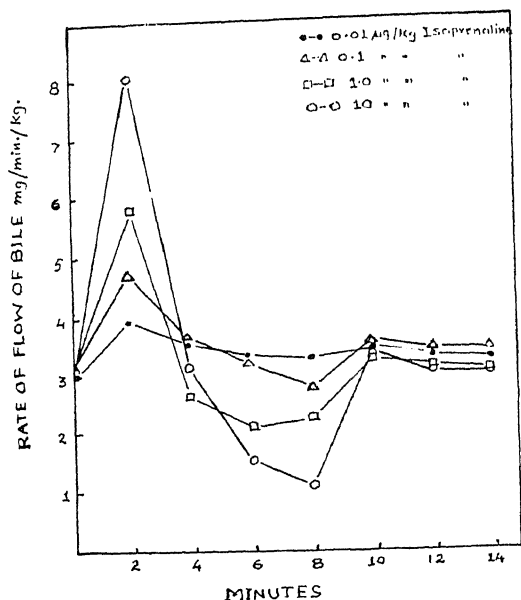
FIG. 1

(Table I). Analysis of bile shows increased bile acids and total solids and decreased cholesterol concentration in the bile collected after the administration of 10 μg./kg. of iso-

TABLE I

Percentage of augmentory and inhibitory biliary response to varying doses of isoprenaline

Dose of isoprenaline (μg./kg.)	Percentage augmentory effect	Percentage inhibitory effect
0·01	27·2	—
0·1	46·8	15·8
1·0	81·2	34·4
10·0	163·5	63·3

prenaline (Table II). These changes were maximum during the augmentory action of isoprenaline and gradually disappeared over a period of about 14-16 minutes. The concentration of bilirubin in bile was not significantly affected.

It is interesting to note that isoprenaline, a β-adrenergic mediator exhibits a potent choleretic action in contrast to adrenaline[1-3] and noradrenaline[4] which are known to reduce bile secretion. The increase in bile acids with concomitant decrease in cholesterol level in bile collected after the administration of isoprenaline indicates the possibility that iso-

TABLE II

Effect of 10 µg./gm. of isoprenaline on composition of bile

(Average of 3 experiments)

Time in minutes		Bilirubin (g./100 ml.)	Bile acids (g./100 ml.)	Cholesterol (mg./100ml.)	Total solid (% w/w)
Conrtol	..	0·090	2·37	83·9	3·7
2 minutes	..	0·106	2·48	76·2	4·1
4 ,,	..	0·106	3·07	48·9	5·1
6 ,,	..	0·096	2·89	41·9	5·6
8 ,,	..	0·090	2·80	48·9	4·5
10 ,,	..	0·090	2·48	55·2	4·5
12 ,,	..	0·106	2·56	65·2	4·5
14 ,,	..	0·090	2·48	62·9	4·2
16 ,,	..	0·090	2·32	76·2	4·2

prenaline increases the biosynthesis of bile acids from cholesterol in liver.

Our thanks are due to Dr. R. L. Nikore for constant encouragement during the progress of the work.

Department of Pharmacy,   A. V. KASTURE.
Nagpur University,   A. K. DORLE.
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PRODUCTION OF ERGOTAMINE PRODUCING STRAINS OF ERGOT IN JAMMU AND KASHMIR

A NUMBER of attempts have been made during the last 25 years to produce ergot in the States of Madras,[3,5] West Bengal[1,4] and Jammu and Kashmir.[2] In all these cases, emphasis has been placed only on "the total alkaloids" irrespective of their nature, whereas the alkaloids needed in medicine are only ergotamine and ergometrine, and the pharmaceutical industry needs large-scale production of sclerotia from only those strains of *C. purpurea* which can produce ergotamine and ergometrine.

In order to select a suitable strain of *C. purpurea* capable of producing significant amounts of ergotamine, several strains of fungus were obtained from East Germany and Czechoslovakia. Nine different strains were tried at the experimental farm at Regional Research Laboratory. The Ootakmond variety of Rye was used as host plant. The crop was planted in the first week of October and the inoculation was carried by spraying a heavy spore suspension of the different strains obtained from the cultures of the fungus on sterilized rye grains. Twelve such sprayings were applied on alternate days. The sclerotia were picked in last week of April and dried at 50° C. Only one strain (R-55) was found promising giving an appreciable yield of ergot. This strain along with another ergotamine-rich strain obtained from East Germany (R-56) was multiplied in isolated plots in an area of 1/20th of an acre. The existing American (R-38) was used as control. The sclerotia obtained from these three strains were chemically analysed for the presence of ergotamine and ergometrine and the results obtained are given in Table I. The two European strains (R-55 and R-56) appear to be very rich in ergotamine. In addition they also contain higher amounts of total alkaloids as compared to the B.P. standard (0·20%). Both these strains also yield crude ergot in quantities which can be economically exploited. These results indicate that it is possible to cultivate economically strains of ergot for the isolation of ergotamine required for therapeutic uses in the country. Pilot scale trials for testing yield of best strains in large-scale cultures were carried out in 1965-66. The strain R-56 has given an average yield of 29·2 kg. per acre when tried on an area of 4·5 acres. It has been also found that this yield could be improved very much by using needle injection method for inoculation.

TABLE I

Yield and alkaloid content of the sclerotia produced by three different strains of Claviceps purpurea in Jammu

Sl. No.	Strain number	Yield of sclerotia per acre in pilot scale experiment	Total alkaloid %	Ergome-trine %	Ergot-amine %
1	R-55	⋅2·3 Kg.	0·21	0·02	0·14
2	R-56	27·0 ,,	0·37	0·02	0·27
3	R-38	22·5 ,,	0·16	trace	0·04

Regional Research Lab.,   AKHTAR HUSAIN.
Jammu, *October* 17, 1966.   K. P. SINGH.

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FOSSIL WOOD RESEMBLING THAT OF *MILLETTIA* FROM THE TERTIARY OF SOUTH INDIA

A PETRIFIED wood of the Cuddalore Series, collected from an area about 8–10 km. W.N.W. of Pondicherry, has shown the following anatomical details :

Wood diffuse-porous (Fig. 1). *Growth rings* present, as indicated by broad fibre bands *Vessels* small to medium, occasionally large, circular to oval, solitary as well as in radial multiples of 2–4, t.d. 56–180 μ, r.d. 52–240 μ, about 1–4 vessels per sq. mm. ; vessel-members 375–450 μ in length, with truncated ends, storied with other elements (Fig. 3); perforations simple ; intervessel pits small, alternate, vestured (Fig. 2). *Parenchyma* abundant, in regular tangential bands alternating with fibre bands of nearly equal width (Fig. 1), bands usually wavy or undulating, often completely enclosing the vessels, 4–6 bands per mm., each 2–9 cells in width, strands storied (Fig. 3). *Xylem rays* 1–3 (mostly 2–3) seriate (Fig. 3), homocellular to heterocellular, composed wholly of procumbent cells, sometimes with single row of upright cells at one or both the ends ; rays 4–20 cells in height, 13–16 per mm., storied. *Fibres* seen as light bands alternating with parenchyma bands, non-septate, thick-walled, storied. *Ripple marks* present, due to storied arrangement of all the elements.

Presence of the banded type of parenchyma, vestured intervessel pits and ripple marks due to storied arrangement of vessel-members, parenchyma strands, xylem rays and fibres— are the most important and diagnostic features of the present fossil wood. Considering them along with other anatomical details the fossil wood shows resemblance with that of *Millettia*[1] of the Leguminosæ. Further, amongst the species of *Millettia* the closest resemblance is shown by *Millettia pendula* Benth.

As far as I am aware this is the first record of a fossil wood resembling that of *Millettia* and hence it is suggested to name it as *Millettioxylon indicum* gen. et sp. nov.
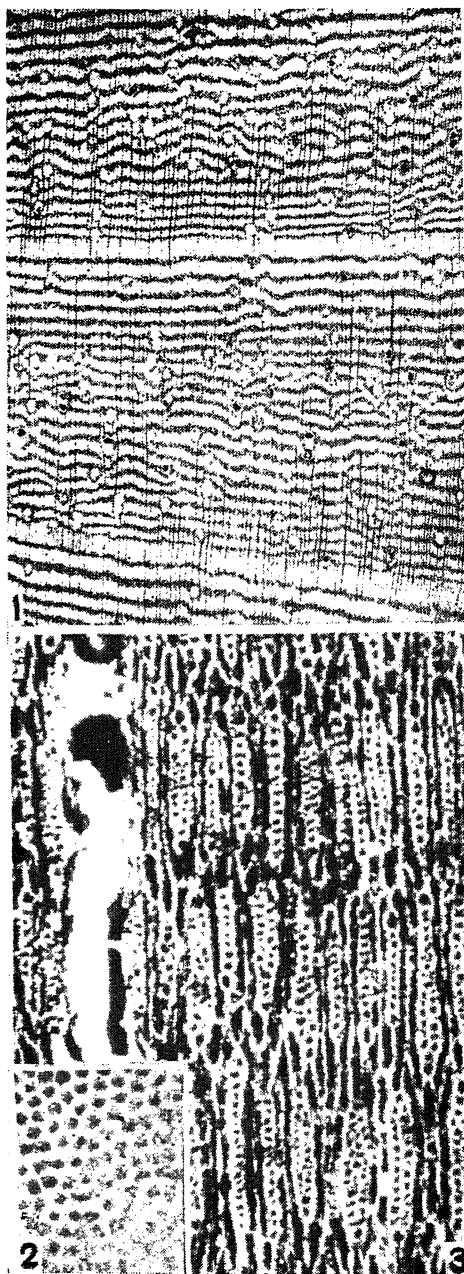
FIGS. 1–3. *Millettioxylon indicum* gen. *et* sp. nov. Fig. 1. Cross-section of the fossil wood showing the nature and distribution of vessels, parenchyma and fibres, × 8. Fig. 2. Vestured intervessel pits, × 480. Fig. 3. Tangential section showing the nature of the rays and their storied arrangement with other elements, × 70.

I am deeply indebted to Dr. R. N. Lakhanpal for guiding me in this investigation and going through the manuscript critically. I am also grateful to Shri K. Ramesh Rao, Forest Research Institute, Dehra Dun, for permission to consult the Xylarium of that Institute.

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NOTE ON A MIOSPORE ASSEMBLAGE FROM GOPAT RIVER VALLEY, M.P.

THE present report deals with the miospore assemblage obtained from a grey shale collected from the outlying shale dumps excavated from a well sunk in the Gopat river bed, about $1\frac{1}{2}$ miles east of Nidpur in Madhya Pradesh. Hughes (1881) assigned the rocks of this area to the Raniganj stage.

The miospore assemblage recovered from the Gopat river sample comprises 24 genera, of which 3 are trilete, 5 are monosaccate, 13 are disaccate and 3 others. The miospore genera recorded are: *Leiotriletes* (Naum.) Pot. & Kr., *Cyclogranisporites* Pot. & Kr., *Microbaculispora* Bharad., *Latosporites* Pot. & Kr., *Virkkipollenites* Lele, *Parasaccites* Bharad. & Tiw., *Vesicaspora* (Schemel) Wils. & Venkatach., *Densipollenites* Bharad., *Striomonosaccites* Bharad., *Platysaccus* Pot. & Kl., *Cuneatisporites* Leschik, *Striatites* Pant *sensu* Bharad., *Verticipollenites* Bharad., *Lahirites* Bharad., *Hindipollenites* Bharad., *Lunatisporites* (Leschik) Bharad., *Striatopodocarpites* (Soritsch. & Sed.) Bharad., *Faunipollenites* Bharad., *Hamiapollenites* Wils., *Rhizomaspora* Wils., *Sulcatisporites* Leschik, *Limitisporites* Leschik *ex* Klaus, *Welwitschiapites* Bolchow. and *Vittatina* Luber.

Of the above the quantitatively important genera are the following: *Leiotriletes* 0·25%, *Cyclogranisporites* 0·50%, *Granulatisporites* 0·25%, *Densipollenites* 16·50%, *Striomonosaccites* 0·75%, *Vesicaspora* 6·50%, *Cuneatisporites* 4·00%, *Platysaccus* 1·50%, *Striatites* 8·50%, *Rhizomaspora* 0·75%, *Lahirites* 10·50%, *Lunatisporites* 1·25%, *Striatopodocarpites* 7·75%, *Verticipollenites* 1·50%, *Faunipollenites* 16·00%, *Hamiapollenites* 1·25%, *Limitisporites* 0·25%, *Sulcatisporites* 21·75% and *Welwitschiapites* 0·25%. Following genera were not encountered in counting: *Microbaculispora*, *Latosporites*, *Virkkipollenites*, *Parasaccites*, *Hindipollenites*, *Limitisporites* and *Vittatina*.

From a perusal of the above list it is clear that the dominant miospore genera in the present assemblage are those which are characteristic of the Raniganj stage (*cf.* Bharadwaj, 1966). These genera are *Densipollenites*, *Striatites*, *Lahirites*, *Striatopodocarpites*, *Faunipollenites* and *Sulcatisporites*. The occurrence, though rare, of the genera *Virkkipollenites*, *Parasaccites*, *Rhizomaspora* and *Limitisporites* may even suggest a Lower Raniganj age.

Birbal Sahni Inst. of   HARI K. MAHESHWARI.
     Palæobotany,
53, University Road,
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DICOTYLEDONOUS LEAF-IMPRESSIONS FROM THE NAHAN BEDS, NORTH-WEST HIMALAYAS

THE plant fossils described herein were collected by one of us (R. S. C.) from the Nahan beds of the Kalka area, in the North-West Himalayas, during the field season April to July, 1964. Nahans (Helvetian-Sarmatian) in this area crop out near Tipra Grahat in the Koshalia Nadi and remain exposed for about two miles up to the village Kamli where the Main Boundary Fault brings them in contact with the Subathus. Lithologically these formations are composed of purple shales and purplish grey to olive green sandstones, the latter are frequently ripple marked and current bedded.

The fossils come from a sandstone bed about 30 m. thick dipping 50° in the north-easterly direction, exposed about four furlongs down hill of the Kalka Water Works on the left bank of the Koshalia Nadi. The sandstone is of greenish-grey to pale-grey colour, medium-to fine-grained with fragments of olive green shale ranging in size from minute microscopic to 15 mm.

Hitherto the beds exposed between the Boulder Conglomerate Zone and the Subathus of the Kalka area have been known as Nahans (Helvetian-Sarmatian). Sahni and Khan (1959) suggest the possibility of correlating these beds with Chinjis (Tortonian), and are of the opinion that these beds may represent the Nurpur series [transitional between Chinji and Nagri or equivalents of Nagri (Sarmatian)].

The fossils are mostly leaf-impressions borne on fine-grained sandstones. In spite of their poor preservation, it is possible to distinguish at least four distinct forms out of the small collection. From their very look, and the venation so far as it is preserved, these leaf-impressions are without doubt dicotyledonous. However in the absence of any dependable characters of taxonomic importance it has not been possible to identify any of these fossils to their respective modern genera. Hence they have been described here under the form—genus *Dicotylophyllum*.

Dicotylophyllum SP. 1

Figure 1 shows a broadly elliptical leaf about 9·5 cm. long and 4·5 cm. wide, with an entire margin. Its apex and stalk are not preserved but the base seems obtuse. It has a strong midrib. The secondaries are not preserved, however at one place there is a suggestion of one or two ill-preserved secondaries arising at about 90°. Other details not preserved.
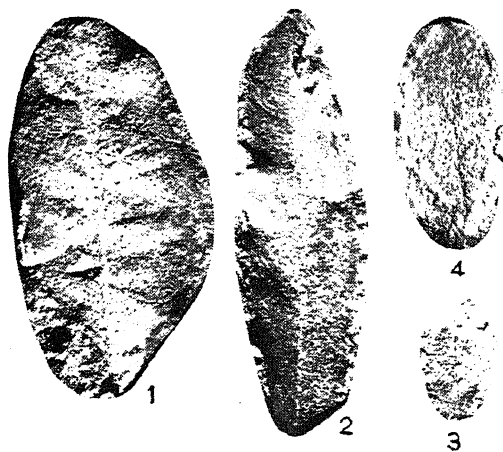
Dicotylophyllum SP. 2

In Fig. 2 a nearly complete outline of an oblong-lanceolate leaf is seen. It is about 11 cm. long and 3 cm. broad with an entire margin. There is a distinct midrib. Finer veins are not preserved ; however, near the base a secondary vein is seen arising at about 45°.

Dicotylophyllum SP. 3

It is a small broadly elliptical leaf about 3 cm. long and 1·6 cm. wide with an entire margin (Fig. 3). Its apex is not preserved and the base appears cuneate. Except for a thin midrib there is no trace of finer venation.

Dicotylophyllum SP. 4

Figure 4 shows an imperfectly preserved leaf about 5·7 cm. long and 2·8 cm. wide with entire margin. Its base and apex not clearly seen. There is a faint midrib. Other details not preserved.

Birbal Sahni Institute of   R. DAYAL.
     Palæobotany,
Lucknow,
          and
Department of Geology,   R. S. CHAUDHRI.
Punjab University,
Chandigarh (India),   *August* 23, 1966.

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NOTES ON A FOSSIL PROTONYMPH OF A FREE-LIVING MITE, *GAMASUS* SP. (ARACHNIDA, ACARINA) FROM DOLOMITE, PUNJAB SALT RANGE

VERY few fossil mites have been recorded from India. Mani (1944 and 1946) described the deutonymph of *Gamasus fossilis* sp. nov. from a rock sample collected by Sahni* from the Worli Hills, Bombay, and one incomplete specimen of protonymph of another Gamasus from Warcha, Punjab Salt Range (now in Pakistan). While working on a piece of Dolomite from Warcha salt mines, collected by Sahni from the junction of Jankush Nullah and Warcha gorge, I came across a fairly well preserved and nearly complete specimen of the protonymph of a free living mite, Gamasus.

Class : **ARACHNIDA**
  Order : **Acarina**
    Superfamily : **PARASITOIDEA**
      Family : GAMASIDAE
        Subfamily : Gamasinæ
          Species : *Gamasus.*

General shape of body elongate pyriform, nearly transparent, almost infiltrated with granules of the matrix. Segmental demarcations indistinct ; surface setæ lost, except a few on legs ; setæ fairly long and needle-shaped. Part of chelate mouth appendage fairly well preserved ; legs incomplete, first two pairs almost fully preserved with tibia, tarsus and pretarsus ; pretarsus with claws. Third and fourth legs on one side missing. Terminal segments of the hind and third legs slender ; but somewhat stouter in others. Tibia short and as long as tarsus ; pretarsus nearly one and

a half times as long as tarsus; claw a little less than half the length of the distal segment of the leg.
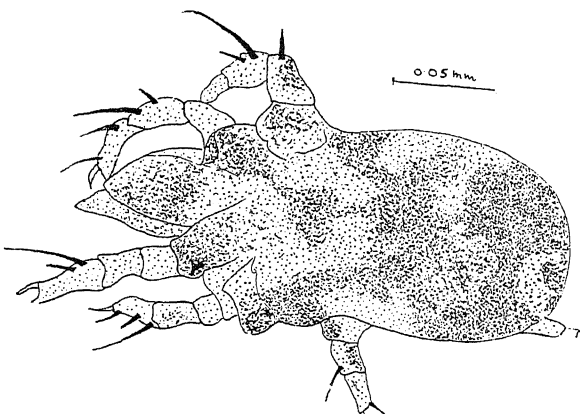
Length of whole specimen .. 0·2104 mm.
Width of whole specimen .. 0·0896 mm.

Type mounted in canada balsam prepared by the author from rock sample (*loc. cit.*).

Department of Zoology,   V. P. GEORGE.
St. John's College,
Agra, *September* 26, 1966.

* Late Birbal Sahni, formerly Director of Palaeobotanical Institute, Lucknow.

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CYTOLOGICAL STUDIES IN TWO SPECIES OF *CASSIA* AND THEIR HYBRID

THE Cassias are important avenue trees which are commonly grown in tropical gardens. Interesting variations were found in flowers and flowering habit of different species of *Cassia* (pink and yellow) growing in the garden of the National Physical Laboratory, New Delhi, which have already been reported.[1] These variants were found to be interspecific hybrids of *Cassia* on the basis of morphological character of leaves, flower structure, flowering habit, etc. One of the variants designated as Hybrid No. 1 and which was outstanding in beauty and flowering habit was thus taken up for cytological investigation along with the suspected parents *Cassia fistula* and *C. nodosa*.

Young flower-buds were fixed in Carnoy's fixative (6 : 3 : 1 of absolute alcohol, chloroform and acetic acid) for about 2 to 4 hours and subsequently transferred to acetic alcohol (1 : 3 of acetic acid and ethyl alcohol) in which the acetic acid was saturated with ferric acetate for 3 to 4 days at 10° C. Acetocarmine squashes were made and the photographs were taken from temporary preparations.

Detailed morphological characters of different species of *Cassia* together with the superiority of the Hybrid No. 1 has already been discussed.[1] Cytological studies on different species of *Cassia* have been made by various workers.[2-4] Cytology of *C. fistula* was studied and the diploid chromosome number was reported to be $2n = 24$ or 28.[2] The chromosome number of *C. nodosa* was found to be $2n = 24$.[3] Both these parental species were studied in the present investigation and cytological analyses were carried out in detail. It was noted during the meiotic study that in *C. fistula*, $2n = 28$ with distinct 14 bivalents at metaphase-I (Fig. 1). 14 chromosomes could also be seen at each pole at anaphase-I. This finding confirms the previous report[2] partially. Almost no variation could be observed in this material collected from the vicinity of the N.P.L. garden.

C. nodosa was studied in detail and it showed that the diploid chromosome number in this species was 28 and not 24 as reported earlier.[3] Metaphase-I showed 14 bivalents very clearly (Fig. 2). Anaphase-I also showed 14 chromosomes going towards each pole. This study does not agree with the previous report of $2n = 24$ in *C. nodosa*.[3] In *C. javanica*, another pink *Cassia* which is very much allied to *C. nodosa* (at times *C. nodosa* and *C. javanica* are bracketed into one species), the diploid chromosome number was observed to be $2n = 28$.[4] Thus it seems fairly certain that the chromosome number of *C. nodosa* is 28 and not 24. Both the parental species showed a fair amount of stability from the cytological point of view. Meiosis in them was quite regular with 14 bivalents in each at metaphase.

The present investigation showed that in the case of the Hybrid No. 1, the diploid chromosome number was 28. Meiosis was quite irregular. Although no multivalents could be seen, 11 to 13 bivalents were usually found in metaphase-I (9 bivalents were noted in one cell only). Univalents varied mostly from 2 to 6 and the mean cytological configuration per cell was estimated to be $11·27_{II} + 3·81_{I}$. This explains the high percentage of pollen sterility in this plant. Chromosomes at metaphase are shown in Fig. 3.

Thus, from this study we confirmed the chromosome number of *C. fistula* to be $2n = 28$. The chromosome number of *C. nodosa* was
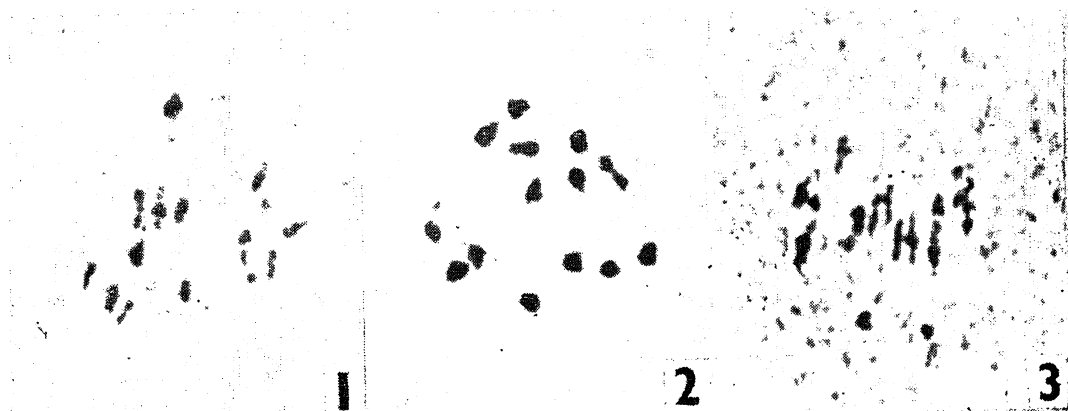
FIGS. 1–3. Figs. 1 & 2. Metaphase-1 in *C. fistula* and *C. nodosa* respectively showing 14 bivalents in each case. Fig. 3. Metaphase-I showing 12 bivalents and 4 univalents, in the hybrid.

established to be $2n = 28$ and not 24 as reported earlier. On the basis of several morphological and cytological studies, the plant named as Hybrid No. 1 now seems definitely a hybrid between *C. fistula* and *C. nodosa*.

The authors are grateful to Dr. B. P. Pal for suggesting the problem and to Dr. M. S. Swaminathan and Dr. V. Swarup for their interest in the study.

Division of Botany,   S. K. BANERJEE.
Indian Agricultural   GOVINDER KAUR BANDA.
    Research Institute,
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GROWTH OF EXCISED ROOTS OF *PHASEOLUS AUREUS*, Roxb., *TRIGONELLA FOENUM-GRAECUM,* Linn., *PISUM SATIVUM,* Linn., AND *CICER ARIETINUM,* Linn., ON NUTRIENT AGAR SLANTS AND STABS

THE rate of growth of the excised roots of *Phaseolus aureus*, Roxb., was different when grown in test-tubes as stabs and slants in a synthetic medium containing agar.[1] Since the seeds used were commercial varieties showing high variability, it was thought desirable to extend the observations to a larger number of roots and compare their performance with those of the excised roots of *Trigonella foenum-græcum,* Linn., *Pisum sativum,* Linn., and *Cicer arietinum,* Linn., grown under comparable conditions. The procedures followed for the sterilization of the seeds and their germination

and the composition of the medium used have been described earlier.[1] The medium had a pH of 5·0. The excised roots were grown in bacteriological test-tubes containing about 5 ml. of the medium for slants and 10 ml. for the stabs. The length of the roots inoculated varied from 4–6 mm. and the graphs are based on several experiments.

The averages obtained for the total growth at the end of five days in the different experiments showed the following variations :—

TABLE I

Range of averages of total growth in mm. at the end of the fifth-day in different experiment

	P. aureus	T. fœnum-græcum	P. sativum	C. arietinum
Stabs	7·3–37·9	16·0–33·6	11·0–25·5	10·3–31·1
Slants	43·4–63·9	14·6–32·3	15·9–24·6	9·4–23·7

A perusal of Graph 1 of the total length on succeeding days would show the wide difference in the rate of growth of the excised roots of *P. aureus* on stabs and slants. The roots of *P. sativum* and *C. arietinum* exhibited relatively better growth on slants. The exception was *T. fœnum-græcum*. On slants, its root tips had a tendency to curl away from the medium leading to an inhibition of growth. Omission of such instances is responsible for the relatively low number (43) of roots analysed.

Graph 2 of the growth per day reveals some interesting details. The excised roots of *P. aureus* alone showed an increasing growth rate in slants from the first day. In both slants (A') and stabs (A) there was a sharp fall in the rate between the fourth and fifth days. If the slowing down of the growth rate between
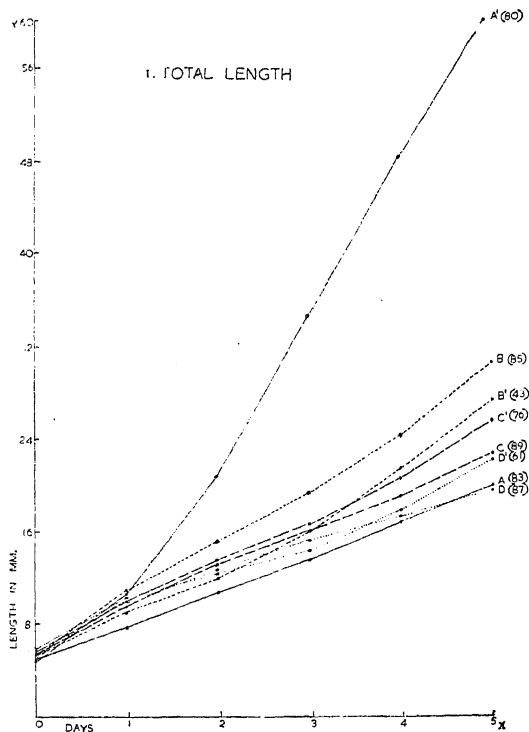
GRAPH 1. Total Length. A–D. Stab Cultures. A′–D′ Slants. A, A′. *P. aureus*. B, B′. *T. fænum græcum*. C, C′. *P. sativum*. D, D′. *C. arietinum*.
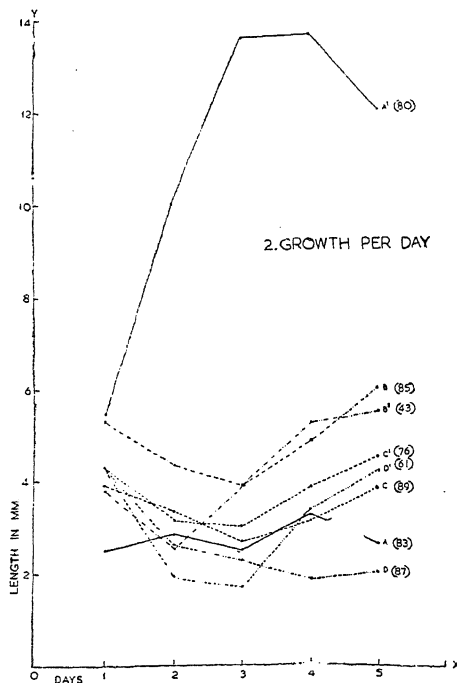
GRAPH 2. Growth per day. The numer of roots on which the averages are based are given in brackets.

the first and third days in the roots of some of the species investigated (*see* Graph 2) is taken as an indication of the time taken to recover from the shock of excision and adaptation to culture in the synthetic medium, the process appears to be relatively quicker when the roots of *T. fœnum-græcum* are grown on slants.

Grateful acknowledgment is made to the Indian Institute of Science and the Council of Scientific and Industrial Research, New Delhi, for their encouragement.

Saraswathy Royan-Subramaniam.*
S. Subramanyam.
G. Meenakshi.
M. K. Subramaniam.
Cytogenetics Laboratory,
Dept. of Biochemistry,
Indian Institute of Science,
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USE OF COMMON HOUSEHOLD MATERIALS AS PREFIXATIVES

The use of prefixing agents in the microtechnique for the clarification of karyotypes has been amply demonstrated by various workers in recent years (Sharma and Bhattacharya, 1960). The widely used prefixing agents are colchicine, 8-hydroxy quinoline, alpha bromo naphthalene and para dichloro benzene. These being costly and sometimes not readily available, trials were made to find out whether any of the commonly available materials can bring about the desired prefixing effects. Some of them gave very encouraging results. The materials used as prefixing agents were camphor, powder of naphthalene balls, eucalyptus oil, coffee, tea, and tobacco. Since the solubility of the first three chemicals in water is very slight, they were used as saturated aqueous solutions. One per cent decoctions of the remaining materials were prepared in boiling water and the filtrate was used. Root tips of *Allium cepa* were treated with these solutions for three hours under refrigeration, and then fixed in propiono alcohol (1 : 1) for 12 hours, hydrolyzed in 1 N HCl for 10 minutes at 60° C., and squashed in 1% lacto propiono orcein (Dyer, 1963).

Material treated with camphor and naphthalene possessed increased number of metaphase plates because of spindle inactivation. The
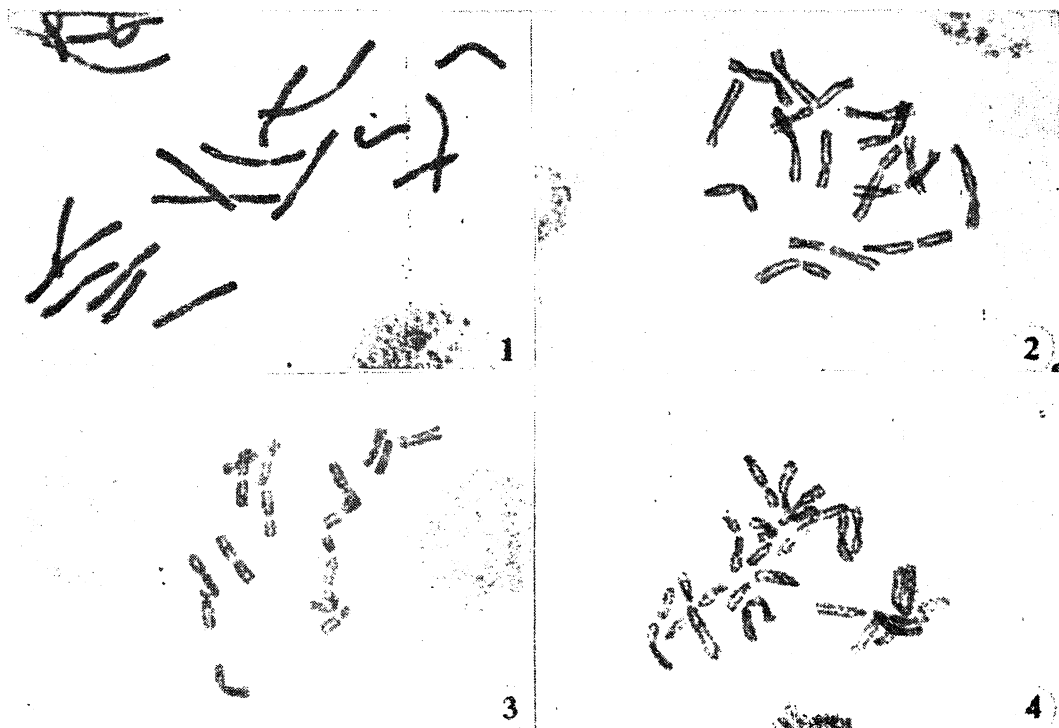
FIGS. 1-4. Fig. 1. Control. Figs. 2, 3, and 4. Treatments with naphthalene, camphor and eucalyptus oil. All figures, × 950.

chromosomes were shorter and thicker with straightened arms, and the centromeres were clear. The chromosome arms were split longitudinally so that the chromatids were clearly visible. Material treated with eucalyptus oil showed all these effects but there was chromosome erosion which made the boundaries of the chromosomes rather rough. There was also frequent clumping of the chromosomes. Metaphase configurations of control and cells treated with these chemicals are illustrated in Figs. 1 to 4. Decoctions of coffee, tea and tobacco had no appreciable effect on the clarification of karyotypes. The prefixing effects of camphor and naphthalene are comparable, though not superior, to any of the widely employed prefixing agents and, therefore, the former could be used when the latter is not easily available.

Cytogenetics Laboratory,   R. D'CRUZ.
College of Agriculture,   P. S. REDDY.
Poona-5, *August* 2, 1966.   G. A. KATWE.

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INVESTIGATIONS ON THE INHERITANCE OF PROTEIN CONTENT IN PEARL MILLET (*PENNISETUM TYPHOIDES* STAPF AND HUBB.)

IN breeding programmes to improve *Bajra* varieties (*Pennisetum typhoides*), an understanding of the relation of protein content to genetic make-up is helpful not only to increase the protein content of the grain but also to help in breeding for other desirable characters. The diallel cross-technique has been used in the present study to elucidate the inheritance of protein content in *Bajra* hybrids.

Grain samples from the inbred parents K. 1-4 (P_1), P.T. 819/4 (P_2), P.T. 852/2 (P_3), P.T. 870 (P_5) and P.T. 888 (P_8) and their F_1 hybrids were drawn from two statistically laid out field experiments (Location 1 and location 2) conducted in the year 1963 at the Agricultural College and Research Institute, Coimbatore. Nitrogen content on moisture-free basis was estimated by Kjeldahl's method and was multiplied by the factor 6·25 to get crude protein percentage. The diallel cross-data were graphically analysed (Jinks and Hayman, 1953) and the genetic parameters (Jinks, 1954) estimated.

TABLE I
Protein percentage in grain—Five-parent diallel cross

| | Mean Values | | | | | | | | | |
| | Location 1 | | | | | Location 2 | | | | |
	P_1	P_2	P_3	P_5	P_8	P_1	P_2	P_3	P_5	P_8
P_1	12·40	16·15	13·24	14·16	13·48	14·65	14·97	12·81	14·40	12·69
P_2		14·90	11·46	14·20	15·29		12·45	16·07	14·83	15·05
P_3			9·65	11·08	17·84			13·23	10·94	11·77
P_5				14·35	11·32				12·60	15·83
P_8					14·95					16·29

a. (W_r, V_r) graph – Location 1; Y = 0.226x + 0.459

b. (W_r', W_r) graph – Location 1; Y = 0.271x + 0.333

c. (W_r, V_r) graph – Location 2; Y = 0.259x − 0.557

d. (W_r', W_r) graph – Location 2; Y = 0.126x + 0.404
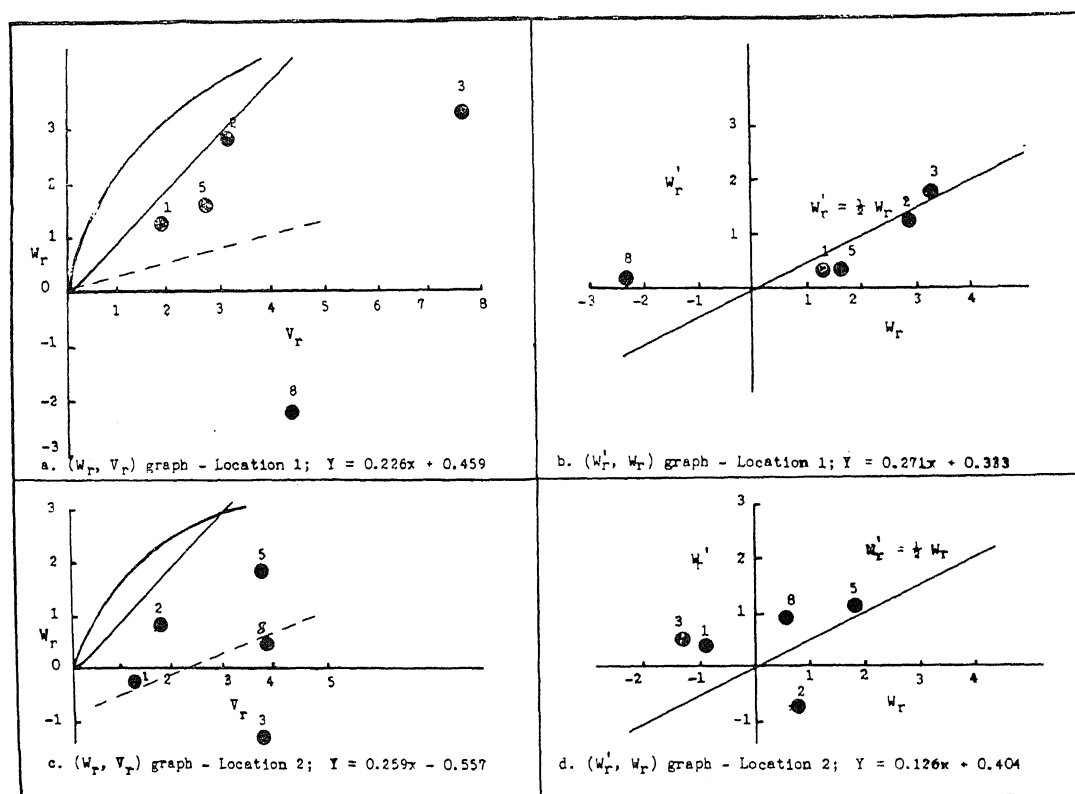
FIG. 1

It is clear from the mean values (Table I) that some hybrids surpassed the mean of the parents in both the locations. Crosses $(P_1 \times P_2)$, $(P_2 \times P_8)$ and $(P_3 \times P_8)$ recorded significant heterosis over the mid-parent value in the first location. The performance of the hybrid $(P_3 \times P_8)$ was outstanding in location 1, while in location 2 it recorded a very low value. Thus, there seemed to be considerable environ-

mental effect. However, in general, the performance of hybrids was either equal to or above the mid-parent value in most of the cases.

While a situation of partial dominance is indicated on (W_r, V_r) graph for location 1, overdominance is indicated by the best fitting regression line on (W_r, V_r) graph of location 2 (Fig. 1). Both the graphs clearly indicate the

TABLE II

	Components of variation	
D	4·71 ± 4·54	0·84 ± 1·73
F	3·29 ± 10·92	2·34 ± 4·32
H_1	14·70 ± 11·07	8·80 ± 4·67
H_2	13·59 ± 10·70	5·21 ± 4·24
h^2	0·44 ± 7·07	0·17 ± 2·77

presence of epistasis. The estimates of components of variance reveal the absence of additivity as well as dominance in both the locations.

The analysis of variance indicated considerable differences among parents and hybrids and the protein content did not seem to have a definite trend either towards increase or decrease in the hybrids relative to the parents. However, it was seldom below the mean of the two parents. The results of the graphical analysis of the two data indicated inconsistency regarding the degree of dominance, while the estimate of H_1 revealed its complete absence in respect of this character. Epistatic gene action was conspicuous from the graphical analysis. The absence of additivity further supports the view that this character is controlled by interacting non-allelic genes to a very large extent. However, the present investigations are only preliminary in nature and a detailed study with more number of parents is to 'be made on this aspect to draw valid conclusions.

I express my deep sense of gratitude to my Professor, Dr. B. W. X. Ponnaiya, for his guidance and encouragement.

Agricultural College   M. MAHADEVAPPA.*
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PRODUCTION OF ENDOCONIDIA BY *PESTALOTIA BRASSICICOLA* KACHROO

DURING the investigations on the behaviour of *Pestalotia brassicicola* Kachroo[1] inciting blackspot of Cauliflower, in artificial media under varying conditions of environment as well as nutrition, several interesting phenomena such as formation of true pycnidia, acervuli, pinnotes, pseudopycnidia and endoconidia were

noted. Of these, the formation of intercalary endoconidia by this fungus in artificial medium was of special interest and forms the subject-matter of this note. Such intercalary endoconidia were frequently noted in 1½ to 2 months old cultures on P.D.A., incubated at low temperature (5–7° C.) in refrigerator, in addition to the several other types of fructifications, a detailed report of which will be made in a subsequent paper.

A critical study into the developmental stages of these endoconidia showed the following pattern and sequence of events in respect of initial organization, septation, colouration and production of distal setulæ.

The first indication was the thickening of certain intercalary cells of the sporogenous mycelium followed by condensation of protoplasm within such cells giving rise to a single-celled protoplast; these then undergo a change and cross-septa are laid down within, accompanied by marked increase in their dimensions. The typical conidial colour develops at the end of five-celled stage, the conidia remaining in chains within the spore mother cell at this stage. The process of development and maturation of the endoconidia is associated with marked bulging of the intercalary spore mother cells, the conidia at this stage falling apart with a single conidium located in each of the intercalary sporogenous cells. The mother cells which give rise to such endoconidia lack any marked specialized structure or form and may be compared to a cylindrical sheath producing within it several endoconidia (generally 2–7) placed end to end in a row (Fig. 1). The
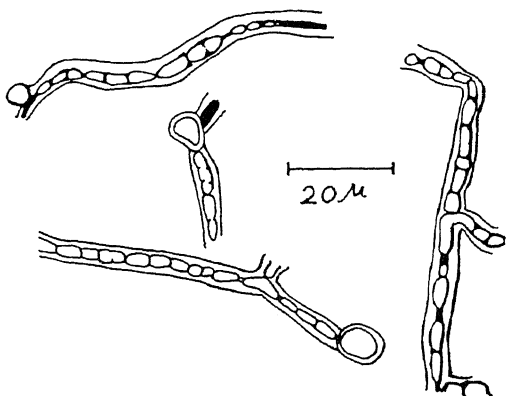
FIG. 1. Photomicrograph showing endoconidia placed end to end.

endoconidia so formed have a structure similar to that of the parent conidia with well-defined conidial morphology but with smaller dimen-

sions and shorter and stiffer distal setulæ, measuring 15·03–25·05 × 3·34–5·9 μ as against 30–32 × 7·25–9·15 μ of the parent conidia. Transfers of the endoconidia to fresh P.D.A. yielded a crop of normal conidia typical of the form-genus.

A special feature of the phenomenon observed in *Pestalotia brassicicola* Kachroo and not so far reported in literature was the formation of endoconidia within the intercalary hyphal cells not differentiated from the normal hyphal cells. Ritchie (1960)[2] working with *Pestalotia aletrides* (Pat.) Guba., noted the production of endogenous conidia extruding out through rupture of the hyphal tips accompanied by the swelling of the mother cells or protoplast lined with a distinct collar around the bulging mother cells. Such a mode of formation of endoconidia is of general occurrence in the lower group of fungi, the *Trichomycetes* as also in the hypho-mycetous genus *Thielaviopsis*. In all such cases so far reported, however, hyphal tips act as "mother cells" or "sporangiole" which are generally specialized in structure distin-guishable from the somatic hyphæ. The pheno-menon observed by the writers in the case of *Pestalotia brassicicola* Kachroo is, however, exceptional and quite distinct from that pre-viously reported by Ritchie (1960)[2] in *Pestalotia aletrides* (Pat.) Guba., thus showing high degree of flexibility of this form-genus in artificial media in respect of the fruiting structures.

It may be mentioned here that the fungus was found to be remarkably uniform and constant in its conidial characters under conditions obtained *in vivo* as well as *in vitro* although considerable variations were noted in respect of fruiting bodies.

M.A.C.S. Laboratory,   M. N. KAMAT.
Poona-4 (India),   J. V. KACHROO.
September 17, 1966.

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TWO NEW RECORDS OF MYXOPHYCEAE FROM GWALIOR (M.P.)

THE present note incorporates record of *Scytonema chiastum* Geitler from Indian soil for the first time and a description of a new form of *Microchæte violacea* Fremy that were collected from Gwalior in the year 1965. These are described below.

1. *Scytonema chiastum* GEITLER (FIGS. 1 AND 2)

Thallus blue green to brown in colour; filaments straight and long, 18·0–24·0 (–28·0) μ broad, richly false-branched, both single and germinate; branches united at the base, long and narrower than the main filament; sheath thick, firm with parallel lamellations, yellowish; trichome constricted, 11·5–15·5 (–21·0) μ broad; cells shorter than broad, mostly barrel-shaped; heterocysts numerous, mostly round or quadrate.

Collected from Tighra dam along with *Nostoc* colonies.

2. *Microchæte violacea* FREMY F. *hyalinus* F. NOV. (FIG. 3)

Filaments occur in cluster of several together, straight or slightly bent at the base, almost uni-formly broad, 10·0–12·5 μ broad; sheath thin, firm, hyaline and unstratified; trichomes 8·5–10·0 μ broad, constricted; heterocyst basal one spherical 10·0–12·0 μ in diameter; intercalary ones square or rectangular, 10·0–12·5 μ broad; 11·0–16·0 μ long.
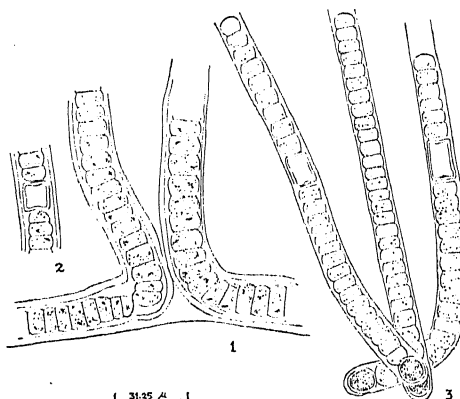
FIGS. 1–3. Figs. 1–2. *Scytonema chiastum.* Geitler. Fig. 1. Filament showing branching. Fig. 2. A portion of the filament with heterocyst. Fig. 3. Filaments of *Micro-chæte violacea* f. *hyalinus* f. nov

Habitat.—Epiphytically growing on *Sirogo-nium* sp. in a pond near Tekanpur Reservoir (Gwalior); collected on 14th November 1965.

Filamenta nonnulla simul aggregate, recta vel paulum curvata ad basin, fere uniformiter lata 10·0–12·5 μ lata; vagina tenius, firma, non-stratitificata et hyalina; trichomata 8·5–10·0 μ lata, constricta; heterocysta basalia quidem sphærica 10·0–12·0 μ diam., intercalaria vero quadrata vel rectangularia, 10·0–12·5 μ lata, 11·0–16·0 μ longa.

Habitat.—Epiphytice insidet *Sirogonio* sp. in lacu prope Tekanpur Reservoir (Gwalior); lect. die 14 novembris 1965.

The form resembles the type in general structure and measurements but differs in the following respects : (*a*) The length of the filament does not exceed more than 450 μ. (*b*) Trichomes are distinctly constricted and pale yellow in colour, almost hyaline (not violet).

I am grateful to Dr. G. S. Venkataraman and Dr. A. K. Verma for their kind help and suggestions and to Dr. H. Santapau for rendering the Latin diagnosis.

Department of Botany,   D. S. AGARKAR.
Government Science College,
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LOCALISATION OF ASCORBIC ACID IN HETEROCYSTS OF BLUE-GREEN ALGAE*

THE function of heterocysts of blue-green algæ is little understood. However, evidence is accumulating in recent years to show that heterocysts are not moribund but metabolically active (cf. Talpasayi, 1965). During a cytochemical study of blue-green algæ it was observed that heterocysts contain ascorbic acid. Many heterocystous algæ that were examined include *Anabæna cylindrica* (Fogg's strain), *Anabæna ambigua* (CCC 1403/7), *Cylindrospermum trichotospermum* (?), *Mastigocladus laminosus* all grown in cultures and species of *Scytonema*. *Rivularia, Calothrix* and *Nostoc* collected from local ponds.

Presence of ascorbic acid was detected cytochemically by acidified silver nitrate method (cf. Chayen, 1951). Algal material was washed in distilled water prior to use. It was soaked in silver nitrate reagent (5 parts ethanol, 4 parts water, 1 part glacial acetic acid and 5% silver nitrate. kept in an amber-coloured bottle) and kept in a light-tight container for 1-24 hrs. At the end of incubation period it was briefly rinsed in distilled water and fixed in 10% sodium thiosulphate solution and examined directly under microscope. Stained material was also dehydrated with ethanol and finally mounted in canada balsam. Intensity of the stain could be increased further by treating the stained material with dilute gold chloride. Presence of ascorbic acid was confirmed also by the use of alkaline TTC reagent (0·25% 2 : 3 : 5-triphenyl-tetrazolium chloride in 0·1 M sodium

hydroxide) which gives a rapid colour reaction (pink crystalline formazan) with aldehyde derivatives of sugars like ascorbic acid (Steigman, 1956).

When stained with silver nitrate reagent, heterocysts show dark brown deposit of silver in them (Figs. 1–4). The intensity of staining in heterocysts as compared with the vegetative cells was always very high. Alkaline TTC was reduced by the heterocysts only and crystals of formazan can be seen in the heterocyst in Fig. 5. Pretreatment of material with hydrogen sulphide to convert any dehydroascorbic acid present to ascorbic acid did not increase the intensity of silver staining. Silver nitrate staining was completely abolished when the material was treated with 5% copper sulphate. There is good reason to believe that ascorbic acid is produced in the heterocysts only in the presence of light as it was consistently observed that material kept in darkness prior to staining showed no reduction of silver nitrate whatever.
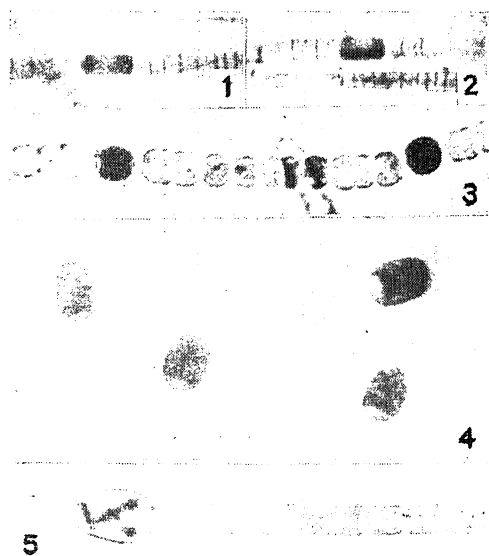
FIGS. 1–5. Figs. 1–4 show heterocysts stained with silver nitrate reagent for ascorbic acid. Fig. 5 shows heterocyst with formazan crystals after treatment with alkaline TTC reagent. Figs. 1 & 2. *Scytonema* sp.. Fig. 3. *Anabæna ambigua*, Fig. 4. *Cylindrospermum trichotospermum*.

Fogg (1951) observed that heterocysts of *Anabæna cylindrica* contain ultra-violet (275 mμ) absorbing materials in them. It could be that ascorbic acid is one of them. Heterocysts appear to be photochemically active as they produce ascorbic acid only when kept in light. It is known that light is required for the biosynthesis of ascorbic acid by green plants (Isherwood

and Mapson, 1962). A recent report by Fay and Walsby (1965) shows that isolated heterocysts are incapable of photosynthetic carbon dioxide fixation. This observation does not necessarily preclude the absence of other biosynthetic reactions of heterocysts that depend on light.

It is difficult to say at present what role ascorbic acid plays in the metabolism of the alga. It may take an active part in the respiratory metabolism of the heterocysts themselves and also possibly of the adjacent cells which later develop into spores. Fay and Walsby indeed showed that isolated heterocysts although devoid of ability to fix carbon dioxide and molecular nitrogen, are capable of high rate of oxygen uptake, nearly one and half times the rate of normal cells. These findings are in agreement with cytochemical findings of Drawert and Tischer (1956), de Puymaly (1957) and Talpasayi (unpublished). Further in algæ where spores develop adjacent to heterocysts as in *Anabæna cylindrica* ascorbic acid appears to influence the development of spores (Wolk, 1965).

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Department of Botany,   E. R. S. TALPASAYI.
Banaras Hindu University,
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* A preliminary account was included in a Symposium of Indian Science Congress (Chandigarh, 1964) held at Calcutta, January 1965.
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PERMANENT PEEL MOUNTS FOR DEVELOPMENTAL STUDIES OF STOMATA IN LEAVES

THE various plant tissues differ in their requirements for preparing squashes. This is particularly true for developmental tissues where cellulose walls are still in the formative stage. Investigators of leaf ontogeny, especially those concentrating on epidermis, also experience difficulty in staining the various parts satisfactorily for cytological work. A. K. Sharma and

Archana Sharma[1] have described a smear technique for the study of chromosomes in leaf tips. Sinclair and Dunn[2] have outlined a method of obtaining surface prints of leaves for phylogenetic studies. Auer[3] used ruthenium red and aniline blue for staining the epidermal cells of *Pulsatila* cotyledons. These methods, though suitable in different ways, have their own limitations. During my studies on the development of stomata in a variety of dicotyledonous plants, I found the following schedule to be quite satisfactory.

The bases of young leaves were selected from young terminal buds and fixed in freshly prepared Carnoy's fixative (acetic acid 1 : absolute alcohol 3) for about 30 minutes. These could then be stored, without any serious deterioration, in 70% alcohol for a considerable period.

Propionocarmine was used for staining (*see* Swaminathan *et al.*[4]). The epidermis was peeled from the fixed leaves and placed on a slide in a drop of propionocarmine. The slide was warmed until acetic acid vapours were given off for 3 to 5 minutes. This helps proper differentiation as well as spreading of the peel (the latter usually gets curled up during its removal from the leaf). It was sealed with paraffin wax. Such temporary mounts proved very useful for immediate study and microphotography.

For preparing permanent slides, the mounts were placed upside down (after removing the wax) across two glass rods in a petri dish and covered with a mixture of 10% *n*-butyl alcohol and glacial acetic acid. After a short while (a few minutes to half-an-hour) the coverslip fell away from the slide. The smears were then passed through a graded series of acetic acid and *n*-butyl acohol (25%–50%–75%–100%) and finally mounted in neutral balsam.

This is an easy technique for the examination of different phases in the ontogeny of leaf epidermis, and formation of the stomatal apparatus.

I am indebted to Professor B. M. Johri for encouragement, and to Dr. P. S. Ganapathy for going through the manuscript.

Department of Botany,   G. S. PALIWAL.
University of Delhi,
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REVIEWS AND NOTICES OF BOOKS

Sand and Water Culture Methods Used in the Study of Plant Nutrition (Second Edition). By E. J. Hewitt. (Commonwealth Agricultural Bureau, Farnham Royal, Bucks and England), 1966. Pp. xiii + 547. Price £ 5 or $ 15.00.

The First Edition of this book, which appeared in 1952, was widely acclaimed and rapidly became the standard reference work throughout the world on techniques used for the detailed and precise study of the growth and mineral nutrition of plants in controlled cultures. It has now been out of print for several years.

In preparing the new edition Dr. Hewitt has consulted many hundreds of additional papers that have appeared since 1952 as well as some important earlier material that has come to light since that date. In addition, many authorities have contributed valuable information in correspondence, and much hitherto unpublished work done by the author and his colleagues at Long Ashton Research Station is described.

In consequence, the book, more than double the size of the first edition and lavishly illustrated, has been fully revised throughout and is completely up to date.   C. V. R.

Application of Fracture Toughness Parameters to Structural Metals (Vol. 31—*Metallurgical Society Conferences*). Edited by Herman D. Greenberg. (Gordon and Breach, Science Publishers, New York), 1966. Pp. ix + 406. Price : Paper $ 10.50 ; Cloth $ 24.95.

The papers that are published in this volume were presented at the 1964 Fall Meeting of the Metallurgical Society of AIME in Philadelphia as a symposium sponsored by the Structural Materials Technical Committee of the Institute of Metals Division.

The titles of the papers contained in this volume are as follows : 1. Theory and Background of Fracture Mechanics, by E. Parker ; 2. Fracture Test Methods and Their Application, by A. J. Brothers and S. Yukawa ; 3. The Use of the Critical Thickness Concept in Design, by R. N. Katz and K. H. Abbott. Discussion by W. W. Gerberich and C. F. Martin ; 4. A Study of the Fracture Resistance of Steel Pressure Vessels by Means of Charpy, Drop Weight, and Full Size Burst Tests, by R. C. Bates and H. D. Greenberg ; 5. Fracture

Toughness Tests for Titanium Alloy Plate and Forgings, by R. W. Huber and R. J. Goode ; 6. Metallurgical Factors Affecting the Fracture Toughness of 18 Ni Maraging Welds, by Z. R. Saperstein, W. V. Mixon, and F. T. Wimmer ; 7. The Effect of Composition on the Fracture Properties of 7178-T 6 Aluminum Alloy Sheet, by D. E. Piper, W. E. Quist, and W. E. Anderson. Discussion by H. Hunsicker ; 8. Influence of Microstructure on the Strength and Toughness of Low Carbon, High Strength Alloy Steel, by P. S. Trozzo and G. E. Pellissier ; 9. A Micro-Fractographic Analysis of Fracture Surfaces in Some Ultra-High Strength Steels, by J. H. Bucher, G. W. Powell, and J. W. Spretnak ; 10. Fracture Micromechanics of Extra-Work-Hardened Type 301 Stainless, by B. R. Banerjee, J. M. Capenos, and J. J. Hauser. Discussion by J. Christian.   C. V. R.

Annual Review of Microbiology (Vol. 20). Edited by C. E. Clifton. (Annual Reviews, Inc., Palo Alto, California, U.S.A.), 1966. Pp. vii + 457. Price $ 8.50. (U.S.A.) and $ 9.00 (elsewhere).

The articles contained in this volume are as follows : Prefatory Chapter : Microbiology—Past, Present, and Future, by C. E. Clifton : Biosynthesis of Lipids in Micro-organisms, by M. Kates ; The Classification of Viruses, by A. Lwoff and P. Tournier ; Biology of the Myxobacteria, by M. Dworkin ; The Relation of the Psittacosis Group (Chlamydiæ) to Bacteria and Viruses, by J. W. Moulder ; Structure and Function in Protozoa, by A. V. Grimstone ; Yeast Genetics, by R. K. Mortimer and D. C. Hawthorne ; Developmental Changes during the Formation and Breaking of the Dormant State in Bacteria, by H. O. Halvorson, J. C. Vary, and W. Steinberg ; Biosynthetic Modifications Induced by DNA Animal Viruses, by M. Green ; Tumor Antigens, by G. Klein ; The Biosynthesis of Bacterial Polysaccharides, by B. L. Horecker ; Interferon, by S. Baron and H. B. Levy ; Microbiology of Waste Waters, by A. F. Gaudy, Nr. and E. T. Gaudy ; Resistance of Plants to Infectious Agents, by J. Kuc ; Microbial Transformation and Transfection, by J. Spizizen, B. E. Reilly, and A. H. Evans ; Suppression, by L. Gorini and J. R. Beckwith and other Reviews of Microbiological Interest.
        C. V. R.

Annual Review of Pharmacology (Vol. 6). Edited by H. W. Elliott. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California), 1966. Pp. vii + 496. Price $ 8.50 per copy (U.S.A.) and $ 9.00 (elsewhere).

Volume 6 of this well-known series contains the following articles : Sidelights of American Pharmacology, by Carl A. Dragstedt ; Aztec Pharmacology, by E. C. del Pozo ; Relationships between Chemical Structure and Biological Activity, Alfred Burger and Anilkumar P. Parulkar ; Cardiovascular Pharmacology, by Francis J. Haddy and Jerry B. Scott ; Electrolyte and Mineral Metabolism, by L. G. Welt, J. R. Sachs, and H. J. Gitelman ; Thrombolytic Agents, by Anthony P. Fletcher and Sol Sherry ; Autonomic Nervous System : Newer Mechanisms of Adrenergic Blockade, by E. Muscholl ; Effect of Drugs on Smooth Muscle, by G. Burnstock and M. E. Holman ; Non-steroid Anti-Inflammatory Agents, by Charles A. Winter ; Comparative Pharmacology, by William G. Van der Kloot ; Perinatal Pharmacology, by Alan K. Done ; Antibacterial Chemotherapy, by Hans J. Eggers and Igor Tamm ; Drugs and Atherosclerosis, by Karoly G. Pinter and Theodore B. Van Itallie ; Renal Pharmacology, by John E. Baer and Karl H. Beyer ; Toxicology, by L. I. Medved and Ju.S. Kagan ; Antibodies of Atopy and Serum Disease in Man, by Mary Hewitt Loveless ; Drugs and Respiration, by Christian J. Lambertsen ; Anesthesis, by Leroy D. Vandam ; On the Mode of Action of Local Anesthetics, by J. M. Ritchie and Paul Greengard ; Review of Reviews, by Chauncey D. Leake.   C. V. R.

Geology of the Alaska Peninsula. By C. A. Burk. (Geological Society of America, 231, East 46th Street, New York, N.Y. 10017), Pp. 250. Price $ 20.00.

The Alaska Peninsula comprises the continental margin of southern Alaska and a part of the Aleutian island arc. Geologically it represents a feature that extends continuously from continental type crust onto oceanic type crust. The response of both types of crust to such a large single structural element should eventually provide new information on the nature of the upper layers of the earth, as well as improve our understanding of the geological history and fundamental structure of island arcs and of the forces of structural deformation. Most of the geological features of the Alaskan Peninsula are also characteristic of other island arcs and continental margins.

Of the five periods of deformation affecting the Alaskan Peninsula, three were associated with plutonic intrusion (early Jurassic, early Tertiary, and mid-Tertiary) accompanied by only structural warping. The mid-Cretaceous deformation is represented by a major hiatus on the Alaskan Peninsula, and probably by thick flysch accumulation at the continental margin. Pliocene deformation was severe and produced essentially all the structural details now exposed in this area.

The volume under review is Memoir 99 of the Geological Society of America. The report, the field work for which was conducted during the summer seasons of 1958, 1959 and 1961, describes the geological history and structural configuration of the Alaskan Peninsula. The text is devoted largely to a presentation of basic stratigraphic relationships and to the interpretation of the structural features and history of the Peninsula. The Memoir includes report on 134 macrofossil collections and 27 microfossil collections. A geological map in two sections at a scale 1 : 25,000, and a tectonic map at a scale 1 : 1,000,000 are also included as Parts 2 and 3 of the publication.   A. S. G.

Selected Papers on Transfer of Radiation. Edited by Donald H. Menzel. (Dover Publication). Pp. 269. Price $ 3.00.

Theories of transfer of radiation have been applied to numerous problems in astronomy, in physics, and in engineering. The source book on the subject is of course *Radiative Transfer* by S. Chandrasekhar, which has now been made available as a Dover paperback. A number of early papers on the subject are still difficult to be consulted. The present compilation will thus serve a needed want. It contains the following papers : 1. Radiation through a foggy atmosphere by A. Schuster ; 2. On the equilibrium of the sun's atmosphere by K. Schwarzschild ; 3. Diffusion and absorption in the sun's atmosphere by K. Schwarzschild ; 4. On the radiative equilibrium of the stars by A. S. Eddington ; 5. Note on the absorption of radiation within a star by S. Rosseland ; 6. Thermodynamics of the stars by E. A. Milne.   A. S. G.

Instrumentation in the Chemical and Petroleum Industries (Vol. 2). Edited by C. W. Sanders. (Plenum Press, 227, West 17th Street, New York), 1966. Pp. 207. Price $ 10.50.

This publication of the Instrument Society of America contains the Proceedings of the

Chemical and Petroleum Instrumentation Sessions held May 26–28, 1965, in Montreal. It also includes some selected papers from the 20th Annual ISA Conference, held October 4–7, 1965, in Los Angeles.

Sixteen papers by 22 participants in this compilation describe the most recent developments in the application of sophisticated instrumentation to the chemical and petroleum industries. Topics include explosion-proof enclosures, international standards, instrument case purging, multicomponent fractionators, sampled and continuous process control systems with random disturbances, applications of direct digital control, logic diagrams, interlock circuits, control in a refinery, and control of a batch exothermic reactor. It includes also the panel discussions.   A. S. G.

Measure and the Integral. By Henri Lebesgue. Edited with a biographical essay by Kenneth O. May. (Holden-Day Inc., 500, Sansome Street, San Francisco), 1966. Pp. 194. Price $7.65.

This book contains translations of two non-technical classics by the inventor of the Lebesgue integral. The first, *Measure of Magnitudes,* which forms the major part of the book (about 170 pages), contains the author's mature thoughts on the nature of numbers, their relation to measure, and the best way to teach these subjects at all levels. The second, *Development of the Integral Concept,* is a short article of 16 pages based on a talk given at the Copenhagen Mathematical Society. It is a readable exposition of the concepts of integration from Cauchy to the generalizations of the Lebesgue integral. The book contains a photograph of Henri Lebesgue and a short biographical sketch by the editor.   A. S. G.

Valency and Molecular Structure (Third Edition). By E. Cartmell and G. W. A. Fowles. [Butterworths and Co. (Publishers) Ltd., 88, Kingsway, London W.C. 2], 1966. Pp. 315. Price 37 sh. 6 d.

The first edition of this popular text for first year honours students in chemistry, was published in 1956 and it went through six impressions. The second edition which came out in 1961 went through four impressions. In this third edition more emphasis is made on use of

molecular orbital theory. Details of structures, bond lengths and bond angles have been brought up to date, and full references have been given to original papers.   A. S. G.

The Wealth of India: Raw Materials [Vol. 7 (N–Pe)]. (Council of Scientific and Industrial Research, New Delhi), 1966. Pp. xxviii + 330 plus ix.

This volume, the seventh in the series on *The Wealth of India,* maintains the high standards of information and get-up which have been the distinguishing features of this great work of national importance in renascent India. It contains 301 entries of which all but 7 (4 animals and 3 minerals), are on plants. Rightly *Oryza* (*O. sativa*) is the most prominent article, about 80 pages being devoted to it. Next comes *Nicotiana* (*N. tabacum*) with 40 pages. Among the other major plants included are *Pennisetum* and *Papaver.* The animals entries are oysters, pangolins, parasitic worms, and peripatus. The minerals entries are nickel ores, petroleum and natural gas, and nitre.

The book is profusely illustrated containing 9 plates (4 coloured) and 140 text-figures.   A. S. G.

Books Received

Survey of Progress in Chemistry (Vol. 3). By A. F. Scott. (Academic Press, Inc., New York), 1966. Pp. xii + 292. Price $7.95.

Developmental Genetics. By F. J. Gottlieb. (Chapman and Hall, London), 1966. Pp. ix + 118. Price £ 10 sh. 6.

Underwater Observation Using Sonar. By D. G. Tucker. [Fishing News (Books) Ltd., 110, Fleet Street, London E.C. 4], 1966. Pp. 144. Price £ 2–0–0.

Techniques and Methods of Polymer Evaluation, Vol. I. *Thermal Analysis.* Edited by P. E. Slade Jr. and L. T. Jenkins. (Marcel Dekker, Inc., 95, Madison Avenue, New York-10016), 1966. Pp. x + 259. Price $10.75.

Chemistry Calculations with a Focus on Algebraic Principles. By A. Vavoulis. (Holden-Day, Inc., Sanfrancisco), 1966. Pp. xii + 140. Price $2.75 (Paper), $5.45 (Cloth).

Handbook of Medical Treatment (Maruzen Asian Edition). By M. J. Chatton, S. Margen and H. Brainerd. (The Kothari Book Depot, King Edward Road, Parel, Bombay-12), 1966. Pp. 726. Price Rs. 18–75.

RADIOACTIVE DECAY OF Re[186]

V. RADHAKRISHNA MURTY

Department of Physics, Panjab University, Chandigarh-14

AND

SWAMI JNANANANDA

Laboratories for Nuclear Research, Andhra University, Waltair

1. INTRODUCTION

THE radioactive isotope Re[186] with $89h$ half-life had attracted the attention of a number of workers,[1-5] as it contains a first forbidden non-unique beta transition. The decay scheme is very simple as shown in the top corner of Fig. 2, and was thoroughly investigated.[6-9] The decay fraction to W[186] is very small. Almost all the activity decays to Os[186] with about 76% decaying to the ground state and the remaining activity mostly going to the strongly converted 137 keV transition. The beta group feeding the 137 keV level has an end-point energy of 927 keV with a first forbidden non-unique shape. Os[186] lies in the transitional region between the strongly deformed nuclei and those of spherical equilibrium shape. Further, the spin sequence of the levels is 0^+, 2_1^+ and 2_2^+. A ratio of 5·6 of the energies of the 2_2^+ to 2_1^+ states enables these levels to be classified as vibrational excitations in non-spherical nuclei. The properties of the first and second phonon vibrational states above the ground state are compared with the predictions of asymmetric rotor model.[10-15] Mainly the photoelectron spectra were studied and the high energy gamma rays are 0·2% or 0·024% intense of the total intensity.[7,9] So far, no complete scintillation gamma spectrum in the decay of Re[186] containing the high energy gamma rays appears to have been published. It is the interest of the present work to study the gamma spectrum including the high energy gamma rays and to determine the relative intensities. Further, the relatively simple decay scheme and the very weak high energy gamma rays ideally suit the 4π sum-peak coincidence method[16] from which fractional intensities of crossover and cascade can be determined. The experimental method for the branching ratios is based on the qualitative comparison of spectra taken with sum (adder) and 4π geometry sum-peak mode. The measured attenuation factors f_m's for zero bias (B = 0) are qualitatively compared with f_γ's for corresponding energies and with general ranges of $f_{\gamma\gamma}$ and $f_{\gamma\gamma\gamma}$. This comparison reveals immediately all peaks due to singles (not summed) gammas and gives at least a qualitative information on types of sum peaks and on magnitudes of mixtures of cascades and crossovers involved. In the simple case of a crossover and one cascade the procedure is quite simple and the fractional intensites can be determined with a knowledge of the experimentally determined respective photopeak efficiencies. Moreover, the experimental values afford a comparison with the theoretical values based on the vibrational as well as asymmetric rotor models.

2. EXPERIMENTAL DETAILS

The experimental set-up consists of two identical 4·45 cm. diam. $\times$ 5·1 cm. NaI (Tl) crystals coupled to DuMont 6292 photomultipliers, whose outputs are added in a linear adding circuit after passing through amplifiers. The two crystals are placed face to face just touching each other, such that it forms approximately a 4π geometry. The integral discriminator outputs of both channels and the differential output of the adder channel are connected in a triple coincidence circuit. Since, the set-up is a simple modification of sum coincidence spectrometer, two de Waard stabilizers[17] of the latter are included, each between the linear amplifier and the photomultiplier through a sine modulated pulse height analyser.

3. RESULTS

The source was obtained in a fine powder form with an activity of 50 mC and allowed to decay for several days to minimize Re[185] content, usually present. A small quantity of the powder is sandwiched in between two films of cellotape. It is placed at a distance of 10 cm. from one of the spectrometers and the singles spectrum recorded is shown in Fig. 1. It shows prominent peaks at energies 137, 630 and 768 keV. The relative gamma intensities are calculated employing the experimentally determined peak-to-total ratios and the detection efficiencies as described by Bell.[18] The gamma intensity of 137 keV transition is assumed to be 10% in the present work and the relative

2
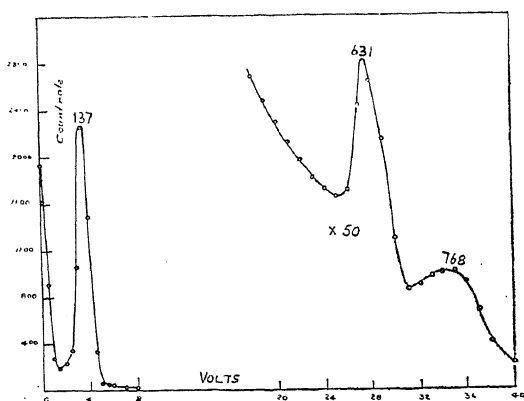
FIG. 1. Singles spectrum of Re^{186}.

intensities computed are given in Table I. Along with these intensities, the total gamma transition intensities computed from the gamma branching ratio and the assumed beta intensities are also given.

TABLE I

Relative gamma intensities

Sl. No.	Gamma energy keV	Metzger and Hill %	Johns *et al.* %	Present work	
				Singles spectrum %	Adder and sum-peak spectrum %
1	137	9	10	10	10
2	637	0·2	0·024	0·368	0·306
3	768	0·2	0·024	0·176	0·204

The set-up is arranged in 4π geometry with the source in between the crystals. The adder and the zero bias sum-peak coincidence spectra are recorded as shown in Fig. 2. The sum-peak coincidence spectrum consists mainly of
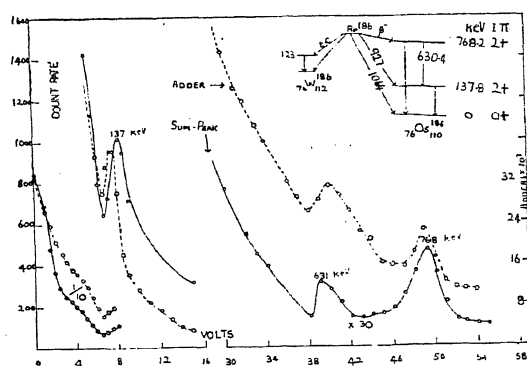
FIG. 2. Adder and zero bias 4π geometry sum-peak coincidence spectrum.

peaks at energies 137, 630 and 768 keV. The attenuation factors for these three transitions

are determined by drawing them on a bigger scale and measuring the areas of these peaks with a planimeter over the continuous pulse height distribution.[16] The measured attenuation factor values (f_m) 0·023 and 0·077 for the 137 and 630 keV transitions are equal to the attenuation factors (f_γ) of single gamma transitions at those energies. The attenuation factors for single gamma transitions are determined for the present set-up in an energy range of 80–1330 keV employing Tm-170, Ce-141, Au-198, Cs-137, Co-60, Sc-46 and Cs-134 sources and a calibration curve is obtained. Further, the photopeak efficiencies are calculated from the given calculated intrinsic efficiency curves for zero distance[19] and the experimentally determined peak-to-total ratios in the above energy range. It can be concluded that alternative decay modes do not exist in the above two cases of 137 and 630 keV transitions. The value (f_m) obtained for the 768 keV transition is 0·3423 which is significantly different from the corresponding attenuation factor $(f_{\gamma3} = 0·084)$ obtained for single gamma transition and that for the cascade $(f_{\gamma 1 \gamma 2} = 0·55)$. The values of $f_{\gamma 1 \gamma 3}$ and $f_{\gamma 2}$ are obtained from the respective attenuation factors $f_{\gamma 1}$, $f_{\gamma 2}$ and $f_{\gamma 3}$ by interpolation. But the value of the attenuation factor f_m is nearer to that of the cascade showing that the contribution of the cascade to the sum line is predominant. The value of the fractional intensity of the cascade is $0·5542 \pm 0·06$. The estimates are expected to be accurate within 10% in general, an error of about 5% being in f_m and another 5% error arising from the errors and uncertainties of the photopeak efficiencies. When the above value for the fractional intensity of the cascade is corrected for the respective photopeak efficiencies, the value is $0·588 \pm 0·06$ and that for crossover is $0·412 \pm 0·04$. The crossover cascade relative intensity ratio becomes 0·7.

The relative intensities of gamma transitions can be obtained from the total branching ratio, obtained by multiplying with $(1 + a_{tot})$ of 768 and 630 keV transitions for internal conversion. But the absence of available total internal conversion coefficients for these transitions in literature because of their small intensities and the exact value of the beta intensity feeding the 738 keV level, render it difficult to determine the gamma intensities. Further, the relative gamma intensity of the 137 keV obtained from the singles spectra has the contribution from 123 keV gamma transition of W^{186} which is fed by ~ 2 to 3% in electron capture decay of $Re.^{186}$ However, assuming the beta intensities

as 1% (300 keV), 19% (927 keV) and 76% (1064 keV) feeding the 768, 137 and 0 keV levels and the internal conversion coefficients to be equal, the relative intensities of gamma transitions are obtained as 137 keV 19·6%, 630 keV 0·6% and 738 keV 0·4% which normalized to 10% intensity for 137 keV transition are given in Table I.

Rotational levels of even nuclei have been treated[10] under the assumption that the nuclei possess equilibrium shapes which are not axially symmetric. The transverse deformation parameter for Os^{186} is 16·5°. The ratio of reduced transition probabilities is obtained as

$$\frac{B\ (E_2\ ;\quad 2_2^+ \to 2_1^+)}{B\ (E_2\ ;\quad 2_1^+ \to 0^+)} = 3 \cdot 188.$$

In the Unified model[20] the same ratio is predicted as 1·43. In the asymmetric rotor model the ratio varies with the transverse deformation parameter (γ), at $\gamma = 0°$, the ratio is 1·43 and at $\gamma = 30°$, it is infinite. In general, the experimental values of this ratio are found to lie in between these two theories. In the transitional region, however, the Davydov and Fillippov model is more successful in predicting this ratio. The experimental ratio in the case of Os^{186} is

$$\frac{B\ (E_2\ ;\quad 2_2^+ \to 2_1^+)}{B\ (E_2\ ;\quad 2_1^+ \to 0^+)} = 3 \cdot 83.$$

The experimental value shows better agreement with the asymmetric rotor model than with the vibrational model.

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CHELATING TENDENCIES OF FERRON WITH SOME BIVALENT METAL IONS*

P. LINGAIAH, J. MOHAN RAO AND U. V. SESHAIAH

Department of Chemistry, Osmania University, Hyderabad

8-HYDROXY quinoline and its derivatives are of unusual importance in analytical chemistry. Ferron, 7-iodo 8-hydroxy quinoline 5-sulphonic acid has been widely recognised as a specific reagent for the spectrophotometric estimation of ferric iron.[1] Further, ferron has been used by Van Zijp[2] as a sensitive microchemical reagent in the detection of barium and strontium. Recently, Nasanen and Ekman[3] have studied calcium-ferron chelate system as regards its stoichiometry and stability constant. However, the chelating tendencies of ferron with many other metal ions have not been investigated. The present communication describes a physico-chemical study of certain bivalent metal ions, Cu^{+2}, Ni^{+2} Co^{+2}, Mn^{+2}, and Zn^{+2}-ferron systems with a view to determine their stoichiometries and stability constants. Further, it has also been aimed to compare these bivalent metal ion-ferron chelate stability constants with those reported values[4] of 8-hydroxy quinoline and 8-hydroxy quinoline 5-sulphonic acid chelates.

The experimental method consisted of pH titrations of the free ligand, in the absence of and in the presence of the metal ion being investigated. The ionic strength was maintained constant by using a medium containing 0.10 M KNO_3 and low concentrations $(1.0 \times 10^{-3} M)$ of the ligand and the metal ion. The pH titrations were carried out by introducing free ligand as well 1:1 and 1:2 ratios of metal ion to ligand concentration into a titration cell. The pH readings were then taken after the addition of small increments of 0.10 M carbon-dioxide-free KOH solutions.

The chemicals employed were all of Analar grade and Leeds and Northrup pH meter (Cat. 7666) with glass and calomel electrodes was employed for the pH measurements.

The required first and second dissociation constants of ferron were calculated from the pH titration curves by an adaptation of Bjerrum's method as followed by Chaberek and Martell[5] using the final equation

$$\bar{n} = (HA^-) + 2(H_2A)/C_A$$

H_2A = Concentration of ferron,
C_A = total concentration of ligand species.

The values of pK_1 and pK_2 for ferron have been found out to be 2.50 and 7.05 respectively $(\mu = 0.10$ M KNO_3 and $t = 28°$ C.). These values are in fair agreement with those reported by Nasanen et al.[6] $(pK_1 = 2.51$ and $pK_2 = 7.41)$.

The pH titrations of ferron produces two sharp inflections which probably correspond to the separate neutralisation reactions

1:2 chelates. The chelate formation may be expressed by the equations (1) and (2)

$$M^{+2} + H_2A \rightleftharpoons MA + 2H^+ \qquad (1)$$

$$M^{+2} + 2H_2A \rightleftharpoons MA_2^{-2} + 4H^+ \qquad (2)$$

The first and second chelate stability constants were calculated from 1:2 titration curves by an adaptation of Bjerrum's method as followed by Chaberek and Martell[5] employing the final equation

$$\bar{n} = \frac{1}{C_M} \left[C_A - \left(\frac{(H^+)^2}{K_1 K_2} + \frac{(H^+)}{K_2} + 1 \right) (A^{-2}) \right]$$

where

C_M = total concentration of metal ion species
C_A = total concentration of the ligand species
K_1, K_2 = first and second dissociation constants of ligands.

The 1:1 copper-ferron stability constant could not be calculated by the Bjerrum's method from 1:2 titration curves. This constant was calculated from the 1:1 titration curve by the algebraic method.[5]

In Table I the relative values of stabilities of various bivalent metal-ferron chelates are presented and also compared with corresponding values for stabilities of 8-hydroxy quinoline 5-sulphonic acid and 8-hydroxy quinoline chelates reported in literature.[4] It is evident from the data that the relative values of the stability constants follow the natural order as proposed by Irving-Williams, $Mn < Co < Ni < Cu > Zn$. And also as was observed by

The pK values of 2.50 and 7.05 may be compared to the corresponding values of 3.84 and 8.35 obtained for 8-hydroxy quinoline 5-sulphonic acid by Martell et al.[4] The lower basicity of ferron may be considered as the result of the inductive effect of the iodide group in 7 position due to which the sulphonic and phenolic protons become much more easily ionisable causing the lowering of pK values.

The 1:1 metal-ligand titration curves showed a definite inflection at two moles of base per mole of metal ion while 1:2 metal-ligand titration curves showed a strong inflection at four moles of base per mole of metal ion indicating the formation of both 1:1 and

TABLE I

Stability constants of bivalent metal ion-ferron and related ligand chelates

$(\mu = 0.10$ M $KNO_3 : t = 28°$ C.)

M^{+2}	Ferron			Log $K_1 K_2$ of	
	Log K_1	Log K_2	Ferron	8-hydroxy quinoline 5-sulphonic acid	8-hydroxy quinoline
Cu	8.33	8.25	16.58	21.87	29.00
Ni	7.70	6.26	13.96	16.77	22.05
Co	6.70	4.17	10.87	15.06	20.81
Mn	4.95	3.15	8.10	11.72	..
Zn	7.25	6.15	13.40	14.32	20.81

Calvin et al.[7] that the plot of Log K_1 K_2 of the above bivalent metal ion-ferron chelates against the second ionisation potential of the metal ions yields a straight line with the exception of Zn^{+2}. Further, the data reveal the fact that as the basicity of the ligand decreases in the order of ferron < 8-hydroxy quinoline 5-sulphonic acid < 8-hydroxy quinoline, the values of stability constants also correspondingly decrease. Thus the lower basicity of the ligand is reflected in a correspondingly lower stability of the metal chelates of ferron.

Further details of these investigations will be published subsequently.

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A GRAPHIC APPROACH IN PALAEOMAGNETIC ANALYSIS

P. C. PAL AND V. L. S. BHIMASANKARAM

Department of Geology, Osmania University, Hyderabad

IN studies in structural petrology the use of equal-density contour lines has long been familiar. Density diagrams thus prepared on the basis of a scatter-diagram in which the individual observations are plotted on a stereographic projection (Wulff net) or on an area true projection (Lambert's equal area projection commonly known as Schmidt net) render it easy to visualize fully the pattern of dispersion of the observations.[1] A similar application can as well be extended to the treatment of the palæomagnetic directions.

The basis of palæomagnetism is that the magnetic vector in a rock is directionally oriented and this direction carries the magnetic history of the rock itself. The basic factors determined in palæomagnetic studies are, therefore, the declination and the inclination values. Since this datum is three-dimensional it is customarily presented in a two-dimensional form by making use of a Wulff net or a Schmidt net. On this net unit vectors representing the individual directions are plotted, no weight being given to the varying intensity of magnetisation values. A 'pole diagram' is thus prepared. While a close grouping of these point-projections of the palæomagnetic directions obtained from the same hierarchical level is always indicative of the reliability of the observations these directions never agree exactly. Instead, a cluster of directions is normally observed. This means that in palæomagnetic studies, as in structural petrology, a scatter of observations projected as points on the net in the form of a pole diagram is encountered. The distribution of the individual points in the pole diagram and their dispersion about the mean value, therefore, need to be summarised by some means in order to evaluate a clear picture of the dispersion trends.

Customarily the palæomagnetic data obtained from a rock unit are analysed statistically following the treatment evolved by R. A. Fisher[2] and the mean declination and inclination values for that particular rock unit are thus estimated. However, the distribution of the points in a pole diagram can also be appreciated if a density diagram is contoured after the manner usually adopted, as mentioned earlier, in structural geology. Since the directions obtained from the same rock unit only approximate a preferred direction (i.e., they would form a coherent distribution if the data is reliable) this preferred direction can be treated as the mean value for the observed unit.

Figure 1 A shown here is a pole diagram of the palæomagnetic directions of 230 Deccan Trap specimens collected from the neighbourhood of Gulbarga.[3] A density diagram corresponding to this data has also been prepared (Fig. 1 B). In a density diagram an area enclosed by a contour line labelled '$x\%$' means that '$x\%$' of the toal points used in the pole diagram lie within 1% of the total surface area of the net. Thus the areas between two different contours indicate the

average percentages of distribution of the total points, the amount of variation of the concentration being determined by the choice of the contour intervals. Since these contour lines indicate the relative spatial concentration of the directions, the maximum in the density diagram represents the area in which the concentration of the points is maximum. This area, therefore, contains the most representative direction for the total distribution and its centre ran be regarded as an estimate of the mean value for the distribution. As illustrated in Fig. 1 B, the

and its density can be treated as an index of the tightness of the group of directional vectors about the true mean direction. In Figs. 2 A and 2 B the pole diagram and density diagram of

FIG. 2. Palaeomagnetic directions of the Deccan Traps of Rajahmundry, Andhra Pradesh. *A.* Pole diagram projected on Schmidt net (All dips up). *B.* Density diagram.

palæomagnetic directions of 34 Deccan Trap samples from an outlier near Rajahmundry[4] are projected respectively.

Table I summarizes a comparative study of the mean values corresponding to the observations illustrated in the above-mentioned

FIG. 1. Palaeomagnetic directions of Deccan Traps of Gulbarga, Mysore. *A.* Pole diagram projected on Schmidt net (All dips down). *B.* Density diagram.

highest contour in the density diagram for the Gulbarga specimens encloses an area where the average concentration is around 25% of the total points plotted in the pole diagram. This means that this concentration represents the directional trend followed by 25% of the vectors plotted as points in the pole diagram in preference to other directions. Since this forms a substantial proportion of the total vectors used in the projection, this area indicates the preferred direction for the total distribution

TABLE I

	Direction of the mean magnetic vector			
	Calculated graph'cally		Calculated statistically	
Sampling site	Decl.	Incl. (Down positive)	Decl.	Incl. (Down positive)
Gulbarga Deccan Traps ..	150°	58°	1 2°	55°
Rajahmundry Deccan Traps outlier ..	302°	−42°	305°	−45°

figures obtained graphically and by Fisher's statistical treatment.

It is evident from Table I that the graphically obtained mean value is appreciably close to that estimated statistically. It is expected that this approach in the analysis of the palæomagnetic data may provide a better understanding of the dispersion of directions, the significance of their concentration, and the pattern of their preferred orientation. Further work on these lines is in progress and will be reported in due course.

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VERSATILE REPRODUCTION IN *LANTANA CAMARA*

T. N. KHOSHOO AND MISS CHARANJEET MAHAL

National Botanic Gardens, Lucknow, India

L. CAMARA Linn., a native of Tropical America, is a very hardy shrub which can grow in poor soil and requires very little care. It has spread to many parts of the old world including India, where it now grows throughout the Deccan Peninsula extending northwards up to sub-mountain regions of the Himalayas. Some varieties are no doubt noxious weeds but others are beautiful ornamentals which bloom nearly the whole year round. The flowers are of various shades of red, orange, yellow and white, giving a striking contrast against its dark green foliage. There is a wide variety of types, differing in the nature of leaves, prickles, bracts, flower colour, etc., which are very difficult to classify because of the extensive reticulation of taxonomic characters. This led Yates[1] of Kew to remark that in Lantanas a "bewildering number of meaningless names" have been used to designate the different types. For such a morpho-taxonomic situation, the nature of breeding system generally offers a valuable key to an understanding of the underlying cytogenetic mechanisms. The present experiments were started with a view to breed Lantanas for ornamental purposes.

Progenies from open pollinated seeds of five cultivars were raised and scored for their morphological and cytological characters. The results, along with those of Raghavan and Arora[2] are summarized with their implications in Table I and Fig. 1.

The ploidy level of the various cultivars of *L. camara* in NBG ranges from 2 X to 5 X. Meiosis is regular in both diploid cultivars, one of which ('Nivea') is male sterile. The other variety, 'Drap D'Or' has very low seed fertility, and the only plant raised from it was triploid.

A character analysis of this 3 X revealed it to be a likely hybrid with 4 X 'Mutabilis'. This implies sexual reproduction. Only one, out of the five plants from male-sterile 'Nivea' (2 X), was perfectly matroclinus. Three other plants, although diploid, are hybrids with related diploid cultivars. The remaining one plant is triploid; its characters indicate it to be a hybrid with 4 X 'Mutabilis'. The results obtained by Raghavan and Arora[2] on this particular cultivar suggest the occurrence of obligate apomixis. In other words, all types of reproduction from sexual to obligate apomixis occur in the diploids.

The 4 X 'Mutabilis has also a regular meiosis with reasonably good pollen fertility. The progeny raised both by us and Raghavan and Arora[2] is matroclinus. In addition, we have observed that no seed is produced from emasculated and bagged flowers, implying thereby that reproduction is either sexual or by obligate apomixis accompanied by pseudogamy. Further work in this direction is in progress.

The reproduction in triploid ('Red Cap' and 'Mutabilis') and pentaploid ('Purple Prince') cultivars appears to be the result of facultative apomixis. These varieties have a highly irregular meiosis and it is unlikely that their normal sexual progeny could be balanced. The progeny obtained is very likely the result of agamospermy or semi-sexuality. All matroclinus 3 X and 5 X individuals must be the result of the former process, while the individuals with higher chromosome numbers are the result of semi-sexuality, *i.e.*, their unreduced eggs get fertilized by pollen from related cultivars. For instance, 4 X and 5 X plants, obtained in the progeny of 3 X 'Red Cap', can arise by the union of its unreduced triploid eggs with X pollen from 2 X

cultivars, and 2 X pollen from 4 X cultivars respectively. Similarly, the 6 X plants from 5 X 'Purple Prince' appear to be the result of 5 X unreduced eggs and X pollen from a related diploid cultivar. These conclusions are not only supported by the morphological characters of the progeny plants, but also by the lack of hexaploid cultivar of *L. camara* in our collection. The

Although final proof of the presence of apomixis has to be obtained by a critical embryological study including the nature of female meiosis, yet it is clear from the foregoing results of the progeny tests that the various wild and cultivated varieties in *L. camara* reproduce both sexually and/or apomictically (Table I and Fig. 1). In view of this, the non-conformity

TABLE I

NAME	2n	PMC MEIOSIS	POLLEN FERTILITY %	OPEN POLLINATED PROGENY			PRESUMED ORIGIN		MODE OF REPRODUCTION
L. CAMARA X=11				TOTAL	MATRO-CLINUS	ABERR-ANT	NATURE	%	
'CRAP D'OR'	22	REGULAR	30.4	1	-	1 (3x)	SEXUAL	100	SEXUAL
'NIVEA'	22	"	NIL	5	1	3 (2x) 1 (3x)	SEXUAL AGAMOSPERMY	80 20	FACULTATIVE APOMIXIS
	22*	"	NIL	6	6	-	AGAMOSPERMY	100	OBLIGATE APOMIXIS
'RED CAP'	33	IRREGULAR	15.6	10	3	6 (4x) 1 (5x)	AGAMOSPERMY SEMISEXUAL	30 70	FACULTATIVE APOMIXIS
	33*	-	47	14	14	-	AGAMOSPERMY	100	OBLIGATE APOMIXIS
'MUTABILIS'	44	REGULAR	90.8	6	6	-	?	-	SEXUAL OR PSEUDOGAMOUS OBLIGATE APOMIXIS
	44*	-	65-90	28	28†	-	?	-	
'PURPLE PRINCE'	55	IRREGULAR	69	3	1	2 (6x)	AGAMOSPERMY SEMISEXUAL	33.3 66.7	FACULTATIVE APOMIXIS
L. WIGHTIANA X=12	72*	-	NIL	32	32†	-	AGAMOSPERMY	?	OBLIGATE APOMIXIS

* FROM RAGHAVAN AND ARORA, 1960.

† ONLY 8 AND 12 PLANTS RESPECTIVELY, SCORED CYTOLOGICALLY, HAD PARENTAL NUMBER.

observations of Raghavan and Arora[2] indicate the occurrence of obligate apomixis in 3 X 'Mutabilis'.

As stated above, hexaploid types of *L. camara* were not available to us, but the data of male sterile 6 X *L. wightiana* (X = 12) obtained by Raghavan and Arora[2] is significant. They found all the 32 plants matroclinus ; out of these, 8 were actually scored for chromosome number which was the same as the mother plant. They suspected the occurrence of apomixis.

A comparison between our results and those of Raghavan and Arora[2] reveals that at Allahabad 2 X 'Nivea' and 3 X 'Mutabilis' tend to be obligate apomicts, while under Lucknow conditions both 2 X 'Nivea' and 3 X 'Red Cap' are only facultative apomicts. Furthermore, seed fertility appears to be higher at Allahabad than at Lucknow.
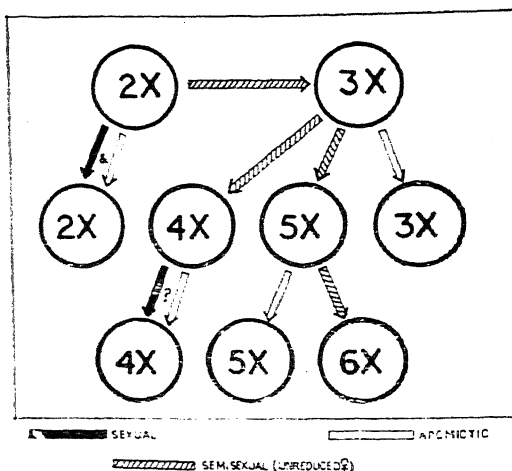
FIG. 1.

between the extent of irregular meiosis and fruit set observed by Natarajan and Ahuja[3] in the species becomes perfectly understandable.

In this taxon there is a combination of traits like efficient vegetative reproduction, cross pollination within various colour forms due to butterfly specificity,[4] high incidence and level of various types of polyploidy, seed dispersal by birds, and, superimposed on these, is in reproductive versatility. Because of the last characteristic, there is a complicated mixture of sexual, semi-sexual and totally apomictic biotypes at various levels and types of polyploidy (Fig. 1). These become the starting points of newer biotypes. Consequently, there is an intricate reticulation of taxonomic differences and it is difficult to recognize discrete taxa morphologically. Furthermore, such a pattern creates a formidable taxonomic problem with its bewildering array of wild and cultivated variants that are generally given an equally bewildering array of names. *L. camara* is, therefore, an *agamospecies* and its problems akin to taxonomic enigmas like *Rubus* with its well-known cases of facultative apomixis.

The above traits in particular the excellent supportive factors like vegetative reproduction and seed dispersal by birds have been responsible for its weedy character and very wide distribution in India and abroad. Lastly, apart from its evolutionary implications, such a genetic system demands that the programme for breeding ornamental Lantanas needs to be reoriented on a different pattern. Considerable genetic variability can be created by a judicious use of sexual and facultative apomictic biotypes.

We would like to enlarge our germ plasm collection of ornamental and wild Lantanas, and any gift of viable seed samples and/or cuttings from India and abroad would be most welcome.

Our thanks are due to Dr. L. B. Singh, Director, for facilities.

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VARANASI MEETINGS ON THE INTERNATIONAL BIOLOGICAL PROGRAMME

RECENTLY a number of ecologists of India met twice in Botany Department of Banaras Hindu University at Varanasi, to discuss the International Biological Programme. Firstly here was a three-week School on Plant Ecology held from October 20 to November 9, 1966, under the direction of Prof. R. Misra. It was joined by about 30 ecologists—all being teachers from different Universities. They practised suitable and standard methods for measuring primary production in forest, grassland and freshwater. A few papers dealing with the flow of energy and mineral cycling within the ecosystems were also discussed. An ecology workbook of about 10 pages was prepared. It was agreed that some teaching of ecology be oriented towards the IBP at both the undergraduate and graduate levels.

The second meeting was a one-week symposium organised by the International Society for Tropical Ecology, from January 16-21, 1967. Twenty-three overseas members from 11 countries and about 125 Indian members discussed thirty-six papers out of a total of 97 received earlier for the purpose. Dr. F. R. Fosberg, Special Adviser for Tropical Biology,

Smithsonian Institution, Washington, was the President of the symposium.

Besides discussion of papers the members considered at some length implementation of the IBP in the tropical countries. Dr. Hugo Boyko emphasized the urgency of the problem. Dr. F. R. Fosberg presented his observations on the economics of the ecosystems of the Pacific Islands. Dr. D. Mueller-Dombois presented a paper on the joint project of the Smithsonian Institution and the University of Hawaii regarding the selection and conservation of sites for research throughout the tropical belt. Prof. R. Misra explained the position and potentialities of the IBP in India. Some of the special problems which India may investigate are: Production responses to exploitation of biota, nutrient turnover in Deciduous forest and grassland, saprophytic and secondary production, nodulation in legumes in relation to the rhizosphere, root production and soil ecosystem, parameters of production measurement, etc. Dr. J. A. Bullock discussed the problems of IBP in the lowland rain forests of Malaysia. Dr. H. Boyko summarized the debate with emphasis on the organisation of training and research in the IBP and resources ecology at suitable centres.

LETTERS TO THE EDITOR

THE CRYSTALLINE CONSTITUENTS OF EUPHORBIACEAE

Part VIII. The Triterpenes of E. antiquorum Latex

WITH a view to examine the unidentified triterpene fraction, the coagulated latex of E. antiquorum[1] Linn. (500 g.) was refluxed with alcohol (2 × 1 l.) and the alcoholic extract saponified with 6% alcoholic KOH. The unsaponified fraction was acetylated with Py-Ac$_2$O over a steam-bath for $3\frac{1}{2}$ hr. This acetate mixture (25 g.) could be fractionally separated from CHCl$_3$-MeOH into four successive fractions.

Fraction A, colourless needles from CHCl$_3$-MeOH, m.p. 242-43°, m.m.p. unchanged by authentic β-amyrin acetate, $(\alpha)_D$ + 91·6°, (C. 1·2 in CHCl$_3$). Upon hydrolysis, β-amyrin[2] was identified by comparison with an authentic sample and preparation of benzoate.

Fraction B, crystallised from CHCl$_3$-MeOH (three times) as colourless plates, m.p. 123-24°, $(\alpha)_D$ - 75° (C, 1·0 in CHCl$_3$) (Found: C. 82·23; H, 11·08; C$_{32}$H$_{52}$O$_2$ requires C, 82·06; H, 11·11%). Hydrolysis with 6% alc. KOH furnished the free triterpene which crystallised from methanol as colourless needles, m.p. 99°, $(\alpha)_D$ - 50° (C, 1·1 in CHCl$_3$) (Found: C, 81·23; H, 11·58; C$_{30}$H$_{50}$O, CH$_3$OH requires C, 81·21; H, 11·79%). After drying at 80°/10 mm. for 8 hr., m.p. 114-115° (Found: C, 84·32; H, 11·9; C$_{30}$H$_{50}$O requires C, 84·50; H, 11·74%); benzoate, colourless needles from CHCl$_3$-MeOH, m.p. 134-135°, $(\alpha)_D$ + 70° (C, 1·0 in CHCl$_3$); ketone, colourless plates from MeOH, m.p. 104-105°, $(\alpha)_D$ + 35° (C, 1·0 in CHCl$_3$). Reduction with Pd/H gave rise to a dihydroacetate, colourless needles from CHCl$_3$-MeOH, m.p. 132-133°, $(\alpha)_D$ + 65° (C, 1·0 in CHCl$_3$) which isomerised with chloroformic hydrogen chloride to give Fraction I, colourless long needles, identical with lanost-9(11) enyl acetate,[3] m.p. 169-171°, $(\alpha)_D$ + 80° (C, 1·1 in CHCl$_3$) and Fraction II, colourless plates, m.p. 136-138°. From these and other reactions, fraction B was regarded identical with cycloartenyl acetate[4] which appears to be the major fraction of the triterpene mixture.

Fraction C, colourless needles from MeOH, m.p. 108-109°, m.m.p. underpressed with authentic euphadienyl acetate, $(\alpha)_D$ + 40° (C, 1·0 in CHCl$_3$). It is hydrolysed with alcoholic alkali to give euphol,[5] crystallised from methanol as colourless needles, m.p. 116-117°, $(\alpha)_D$ + 32° (C, 1·2 in CHCl$_3$).

Fraction D, appeared to be a mixture and therefore it (1 g.) was deacetylated and chromatographed over alumina (30 g.). Petroleum ether eluted euphol (identified as its acetate and benzene eluted a compound which gave an acetate, colourless needles from MeOH, m.p. 124-125°, unchanged by authentic euphorbol acetate, $(\alpha)_D$ ± 0° isolated from E. cattimandoo[6] latex (Found: C, 81·97; H, 11·41; C$_{33}$H$_{54}$O$_2$ requires C, 82·17; H, 11·20%). Pure euphorbol was obtained by hydrolysis of the acetate, shining plates from MeOH, m.p. 126-127°, $(\alpha)_D$ ± 0°. (Found: C, 84·49; H, 11·22; C$_{31}$H$_{52}$O requires C, 84·53; H, 11·81%), benzoate, crystallised from CHCl$_3$-MeOH as needles, m.p. 134-136°, $(\alpha)_D$ + 20° (C, 1·8 in CHCl$_3$).

The separation of the acetate mixture from the latex by chromatography over alumina was found to be effective, but laborious and required large quantities of petroleum ether as eluant.

The present sample did not contain the dihydroxy triterpene reported in an earlier one.[1] The identification of β-amyrin, cycloartenol uphol and euphorbol was possible only after saponification.

All the compounds recorded in this paper analysed satisfactorily.

Dept. of Chemistry,   V. ANJANEYULU.
Andhra University,   L. RAMACHANDRA ROW.
Waltair, December 16, 1966.

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CHEMICAL EXAMINATION
OF THE ESSENTIAL OIL OF
CYATHOCLINE-LYRATA (CASS.)

CHEMICAL investigation of this oil has been carried out and the various components have been characterised as β-selinine (3·1%); -δ-selinene (3·5%), camphor (3·0%); thymol (3·4%); thymol acetate (6·7%); lyratol (20·2%); lyratol acetate (49·9%); lyratoic acid (1·7%). These components except camphor are different from those reported by Nigam and Purohit.[1,2]

The steam distillation of the plant yielded a brown oil (0·4%) having the following properties n_D^{27}, 1·465; $(a)_D^{27} + 5·35$; d_{27}^{27}, 1·12505; acid value before and after acetylation, 6·181 and 6·215 respectively; ester value before and after acetylation 201·4 and 238·9 respectively; and boiling range of the oil 110–140°/12 mm.

The oil (125 g.) was separated into acidic (2·5 g.) and neutral (120·4 g.) parts by treating with an aqueous KOH solution (5%). The acidic part in ether was treated with saturated sodium bicarbonate solution and the sodium bicarbonate extract on acidification yielded an oily product (2·1 g.), b.p. 110° (bath)/4 mm., neutralization equivalent, 164 and analysed for $C_{10}H_{14}O_2$. This was identified to be lyratoic acid because of its identical properties with the acid obtained by both Jone's oxidation[3] and active MnO_2 oxidation[4] of lyratol(1). The residue after sodium bicarbonate washings was identified to be thymol by its melting point, mixed melting point, analysis, and also by the superimposition of the IR bands with that of an authentic sample of thymol.

Neutral part (10 g.) was chromatographed on alumina grade III (300 g.) and the following fractions were collected: (1) Pet. ether (40–60, 800 ml.), 4·6 g. (2) Ether, (500 ml.), 5·0 g.

The pet. ether fraction (4·8 g.) was again chromatographed on alumina grade II (240 g.) and the following fractions were collected: (a) pet. ether (40–60, 150 ml.), 0·83 g. was found to be a mixture of five hydrocarbons by IR, GLC and TLC analysis. (b) Pet. ether : benzene (1 : 1), 4·56 g. Fraction a' was chromatographed on silica-gel impregnated with silver nitrate column[5] and pet. ether benzene (1 : 1) fractions, 25 ml. each were collected when two of the hydrocarbons were collected in GLC/TLC pure state. One component, b.p. 130° (bath)/4 mm.; n_D^{30} 1·4964; $(a)_D^{30} + 56·02$ (conc. 2·26%) analysed for $C_{15}H_{24}$ was characterised as β-selinene through its selenium dehydrogenation product and also by the comparison of its IR

and NMR spectra with an authentic sample. Second hydrocarbon component, b.p. 150° (bath)/1 mm.; n_D^{28} 1·4969; $(a)_D^{26}$ 168·9 (conc. 2·85) analysed for $C_{15}H_{24}$; IR bands at 1640, 1613, 1451, 1370 and 877 cm.$^{-1}$; UV absorption maxima at 240, 248 and 256 mμ (ϵ values as 18985, 20068, 12465 respectively) correspond with -δ-selinene.[6] The identity of -δ-selinene was confirmed through selenium dehydrogenation product and also by its NMR spectrum which showed signals at 8·89, 9·0, 9·09, 8·34, 3·94 τ.

Fraction b (3·6 g.) was rechromatographed on alumina grade II (190 g.) and the following fractions were collected. (1) Pet. ether : benzene (3 : 1, 150 ml.), 0·3 g.; (ii) pet. ether benzene (2 : 1, 150 ml.), 0·67 g.; (iii) pet. ether : benzene (1 : 1, 250 ml.), 2·41 g. Fraction (i) was characterised as d-camphor through analysis, m.p. and m.m.p., IR and D.N.P. derivative. Fraction (ii) b.p. 85 (bath)/4 mm.; n_D^{28} 1·5346 analysed for $C_{12}H_{16}O_2$ was identified to be thymol acetate through its IR and hydrolysis to thymol. Fraction (iii) b.p. 132° (bath)/11 mm.; n_D^{28} 1·4670, $(a)_D^{27·5}$ 23·6 (conc. 4·31%) analysed for $C_{12}H_{18}O_2$ was characterised as lyratol acetate because of its consistency with an authentic sample of lyratol acetate obtained from lyratol. It was further confirmed by its IR, NMR and hydrolysis to be lyratol.

Fraction 2 (12·5 g.), *i.e.*, ether elution of the neutral part of the oil was chromatographed on silica-gel and the benzene elution (6·4 g.) was identified to be lyratol acetate as above; pet. ether : benzene (1 : 1) elution (0·8 g.) was identified as thymol as before and ether elution (5 g.) b.p. 105° (bath)/2 mm.; $(a)_D^{27}$ 62·3 (conc. 4·6%) n_D^{30} 1·4761 analysed for $C_{10}H_{16}O$ was identified as lyratol (1) by IR, UV, NMR and chemical evidences.
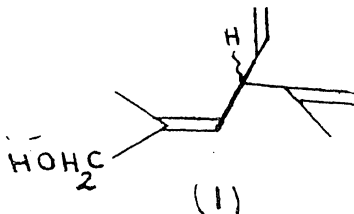
The complete chemistry of lyratol, lyratol acetate and lyratoic acid would be communicated separately.

School of Studies in   O. N. DEVGAN.
        Chemistry,   M. M BOKADIA.
Vikram University,
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CHEMICAL EXAMINATION OF THE SEEDS OF *SISYMBRIUM IRIO*, LINN.

Sisymbrium irio commonly known as Khaksi or Khubkalan belongs to the family Cruciferæ. Its seeds are reported to be expectorant, stimulant and restorative. It is externally used as a stimulating poultice, and is used in asthma also.[1]

So far the plant has been investigated only for fatty oils[2] and carotenes.[3] In the present communication the isolation and characterisation of a flavonoid from the seeds are reported.

The alcoholic extract of the defatted seeds gave a pink colour with magnesium and hydrochloric acid.[4] The concentrate was hydrolysed with 7% H_2SO_4. A semi-solid mass thus obtained on several crystallisations from methanol melted at 304–305°. Chromatography using Whatman filter-paper No. 1 and BuOH : AcOH : H_2O (60 : 10 : 20) as solvent showed a single spot in U.V. light and ammonia vapour. Mixed m.p. with an authentic sample of isorhamnetin was undepressed. It gave an acetate m.p. and mixed m.p. 198–201°: Its identity as isorhamnetin was confirmed by U.V. spectra and co-chromatography.

The author is thankful to Hakeem Abdul Hameed and Prof. A. R. Kidwai for their encouragement and interest in this work. His thanks are also due to Dr. W. Rehman for a sample of isorhamnetin.

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ANALYSIS OF SYNTHETIC MIXTURES OF IRON AND MANGANESE

VERY few methods are available for the extraction of manganese. In this laboratory the distribution of various metals in the two-phase system sodium formate-pyridine[1] is being studied. The extraction of manganese has been studied in detail and is applied to the separation of the synthetic mixtures of manganese and iron. The results are presented in this communication.

The distribution of manganese in the sodium formate-pyridine system is governed by the Nernst's law and maximum extraction of manganese into pyridine is obtained under the following conditions :

Volume of Pyridine = 5 ml.
Volume of Formate = 5 ml.
(3M)
pH = 6·0–6·4

and an almost complete extraction of manganese is attained by a four-stage Batch extraction process.

Preliminary experiments showed that ferric iron is completely retained in the formate layer under the conditions described above while manganese is extracted into pyridine. Therefore experiments are carried out taking synthetic mixtures containing different concentrations of manganese and iron in 5 ml. 3 M sodium formate. The whole of manganese is extracted by adding additional aliquots of pyridine and the total manganese is determined polarographically[2] while the iron in the formate layer is also determined polarographically.[3] The results of a typical set of experiments are given in Table I.

TABLE I

Amount added (mg.)		Amount found (mg.)	
Manganese	Ferric iron	Manganese	Ferric iron
5·50	6·05	5·45	6·00
4·40	4·84	4·40	4·80
2·75	2·42	2·75	2·40

Dept. of Chemistry,   G. S. DESHMUKH.
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Varanasi-5,   S. V. S. S. MURTY.**
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TOLERANCE STATUS OF SOME RATS TO AN ANTICOAGULANT RAT POISON

LUND[2] had shown that *R. norvegicus* showed a tolerance to warfarin. Deoras[1] has shown that *Rattus rattus rufuscens* particularly from the hinterland seemed to tolerate locally made warfarin in the doses which showed tolerance in *R. norvegicus*.

Experiments have since been done with 0·025, 0·05, 0·1 and 0·5 percentage of locally available anticoagulant Rodafarin with locally available *R. rattus*. This has shown that, though there is mortality after a continuous feeding in the laboratory with field concentrations of 0·025%, this decreases as the concentrations are increased. Secondly, if the warfarin is given along with other food, as will be available in nature, the percentage mortality is very low and the rats have not died even beyond 20 days. Table I shows the percentage mortality in

6 days, 10 days and 20 days with different concentrations of warfarin on *R. rattus*. The rats seem to have survived the critical dose worked out by Hayes[3] and Gaines for these rats.

The warfarin ratticide is not extensively used in India. In Bombay it is partially used since 1952. The tolerance therefore seems to be a kind of natural phenomenon. Having seen this in *R. rattus* it was necessary to see the same in two other locally available rats, *i.e.*, *R. norvegicus* and *B. bengalensis*. The last rat is a field rat, bigger than *R. rattus* and seems to do more damage. Experiments were done as before with the field dose of 0·025% warfarin along with normal food and the results are shown at Table II. It will be seen from this table that the field rat even though heavier, dies earlier than the other two.

Further experiments with a lower dose of 0·005% of warfarin given for 6 days only, were

TABLE I

Showing the performance of R. rattus *to warfarin (Rodafarin) in different concentrations and along with other food*

No. of rats used	Average weight of rats in gm.	Con. of Rodafarin	Up to 6th day			Up to 10th day			Up to 20th day			% Survival after 20 days	Days of death up to 20 days			Av. mg./kg. warfarin taken to die
			Bait in gm. Av.	Normal food in gm. Av.	% Mortality	Bait in gm. Av.	Normal food in gm. Av.	% Mortality	Bait in gm. Av.	Normal food in gm. Av.	% Mortality		Max.	Min.	Average	
10	105·3	0·0025	22·5	..	40	31·9	..	70	..	..	..	30	9	3	5·8	7·6
10	101	0·005	21·0	..	50	21·1	..	70	34·9	..	90	10	20	3	8·1	17·8
10	105·8	0·01	16	..	20	31·4	..	90	34·3	..	100	..	14	3	8·4	32·03
10	104·3	0·025	23·4	..	80	29·0	..	100	..	..	..	..	9	3	5·9	71·0
10	108·6	0·05	24·75	..	80	29·7	..	100	..	..	..	..	10	3	5·2	135·0
10	92	0·025	14	29	10	16·5	64	20	22·8	51·27	70	30	17	6	12·1	48·9
10	106·8	0·05	17·1	58·1	20	13·75	37·7	40	17·1	58·1	70	30	18	5	10	79·7
10	103·4	Control	..	57·3	10	..	..	..	..	..	..	90	..	2	..	..

TABLE II

Showing the comparative performance of three kinds of locally available rats to warfarin (Rodafarin) given up to 20 days along with normal food

No. of rats used	Sp. of rat	Av. weight of rat in gm.	Con. of Rodafarin	Up to 6th day			Up to 10th day			Up to 20th day			% Survival after 20 days	Days of death			Av. mg./kg. warfarin taken to die
				Bait in gm. Av.	Normal food in gm.	% Mortality	Bait in gm. Av.	Normal food in gm.	% Mortality	Bait in gm. Av.	Normal food in gm.	% Mortality		Max.	Min.	Average	
8	Rr	96·3	0·025	34·0	18·8	50	34·0	18·8	50	34·0	38·3	75	25	25	4	12·1	90·5
8	Rn	228	0·025	24·3	88·3	37·5	24·0	83·3	50	34·0	89·2	75	25	14	3	7	41·0
10	Bb	123·1	0·025	38·8	49·3	100	..	..	..	..	..	..	..	6	3	5·7	79·66

Rr. *Rattus rattus*;   Rn. *Rattus norvegicus*;   Bb. *Bandicota bengalensis*.

TABLE III

Showing the performance of the field rat B. bengalensis to a laboratory concentration of Rodafarin (0·005%) given up to 6 days only and then switched to normal food

No. of rats used	Sp. of rat	Av. weight of rat in gm.	Con. of Rodafarin	Percentage mortality and bait consumption									% Survival after 20 days	Days of death			Av. mg./kg. warfarin taken to die
				Up to 6th day			Up to 10th day			Up to 20th day				Max.	Min.	Average	
				Bait in gm. Av.	Normal food in gm.	% Mortality	Bait in gm. Av.	Normal food in gm.	% Mortality	Bait in gm. Av.	Normal food in gm.	% Mortality					
20	Bb	247	0·005	50·1	..	70	59·5	..	90	65·1	..	100	..	12	2	6	16·79
20	Bb	160	0·005	42·0	..	70	55·7	..	100	..	..	..	..	8	3	5·6	18·5
20	Bb	125·4	0·005	47·4	..	65	56·7	..	95	56·7	..	95	5	10	4	5·8	19·4

Bb. *Bandicota bengalensis.*

done with B. *bengalensis*. The rats were given normal food after 6 days. Table III, which is the summary of these experiments on 60 rats shows that B. *bengalensis* continues to die even after consumption up to 6 days only, with this lower concentration, which does not kill R. *rattus* which is a much smaller rat. R. *rattus* has not died when bait consumption was suspended after 6 days and switched to normal food. It is therefore summarised that R. *rattus* in Bombay shows tolerance in even heavier doses of locally made warfarin and that the field rat is at present quite susceptible even in smaller doses which are taken as standard showing resistance in R. *norvegicus* by Lund.[2]

I am extremely thankful to my colleagues, Mr. Chaturvedi, Mr. Renapurkar and Mr. Gokhale for assistance in these experiments, and to the Haffkine Institute for facilities. The entire warfarin as Rodafarin was very kindly made available to us by Dr. R. C. Shah from Messrs. Pest Control for which we are thankful to both.

Haffkine Institute,   P. J. DEORAS.
Bombay, *October* 14, 1966.

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A DIFFUSIBLE WATER-SOLUBLE ANTIGENIC FRACTION EXTRACTED FROM *BR. ABORTUS* CELLS

ANTIGENS of B. *abortus* have been studied by various workers. The method of extraction of antigen according to most of the workers has been either by subjecting the cells to ultrasonic disruption or treating the cells with phenols and acids.[1-3] It was also reported that phenol extracts of Brucella species could be used for serologic reactions but were not antigenic.[4] The diffusible antigens of Br. *melitensis* have, however, been studied by obtaining water-soluble fractions besides its phenol and trichloracetic acid extracts. A diffusible precipitin antigen could not be prepared from Br. *abortus* and Br. *suis* cultures by similar methods which were effective in producing such an antigen from Br. *melitensis*.[5,6]

The present communication reports the preparation of a diffusible water-soluble antigenic fraction of Br. *abortus* which can also be used in the study of the organisms by gel diffusion precipitin technique.

The bacteria were grown on tryptose agar plates under CO_2 tension for 4 days, suspended in sterile 0·85% sodium chloride solution, washed three times by high centrifugation in sterile saline, and stored at 4° C. until the desired quantity was obtained. The method described for isolation of a soluble antigen of V. *fœtus*[7] and also reported successful in the study of characterisation of Actinobacillus species,[8] was employed for the extraction of the heat stable water-soluble fraction of Br. *abortus* (Strain 544 and a local strain).

This heat stable, water-soluble fraction appeared to be polysaccharide in nature as it reacted positively to Molisch test and negatively to the biuret, Millon and ninhydrin tests for proteins. The individual seven amino-acids were identified in the acid hydrolyzate of the fraction by two-dimensional chromatography. The maximum ultraviolet absorption exhibited by this water-soluble fraction was at 258–260 mμ.

When reacted with sera of varying agglutinin titres from brucella infected animals the water-soluble antigen extracted from both the strains (*loc. cit.*) gave one to three lines of precipitin

depending on the titre of the serum. When injected parenterally into rabbits and guinea pigs, this fraction produced antibodies (both agglutinins and precipitins) in high titres by intravenous, intramuscular and subcutaneous routes.

The presence of amino-acids in the fraction represents a protein complex to which a polysaccharide molecule is also attached. The presence of the conjugated ring system of the purins and pyrimidines in nucleic acid is known to result in marked absorption in the UV absorption maxima near 260 mμ. As such the exact nature of this fraction appears to be that of a nucleoprotein. The polysaccharide moiety of this purified preparation suggests its complex haptenic nature which contributes increasingly to the antigenicity of this fraction.
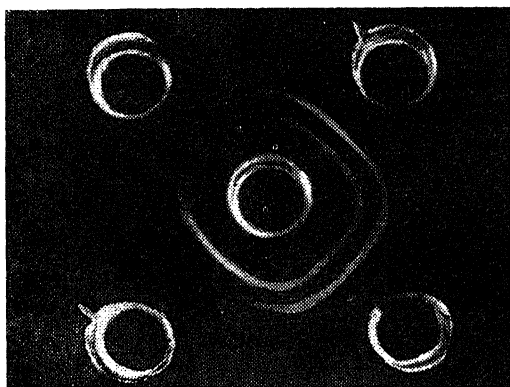
FIG. 1. Showing precipitin lines in gel. (The third line is faint). The central cup contains the antigenic fraction and peripheral cups sera of varying agglutinin titres from *Brucella* infected animals.

Thus the immunologically reactive nucleoproteins and serologically active polysaccharide hapten in this antigenic fraction not noly make it useful as a tool for the study of the antigenic structure of the genus but can also be employed in the field of diagnostic serology. Additional studies would be needed to determine the efficacy of this fraction in immunization of small animals as also for its application in various tests like Passive hæmagglutination and conglutinin complement absorption test.

We thank Principal C. V. G. Choudary for the facilities provided.

U. P. College of Veterinary   R. C. PATHAK.
    Science and Animal Husbandry,
Mathura,   and
Indian Veterinary Research   C. M. SINGH.
    Institute, Izatnagar (Bareilly),
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TISSUE HYDRATION IN RELATION TO DROUGHT RESISTANCE IN RICE

AMONG the theories put forward to explain drought resistance in crop plants, the one that gained wide acceptance is the ability of the protoplasm to maintain higher water potential at wilting stage (Asana, 1960). A study was undertaken at the Central Rice Research Institute, Cuttack, to see whether this held true in the case of rice.

Seeds of known drought resistant (*Mtu.* 17 and *W.* 418) and drought susceptible (*Co.* 13 and *B.* 76) varieties were sown by dibbling in the field and the crop was grown under normal irrigation (approximately field capacity) upto 30 days. Subsequently it was subjected to drought by withholding irrigation. Soil samples (20 cm. depth) and shoot samples were collected at weekly intervals up to 60 days growth of the crop and the percentage of moisture in both were determined by desiccation in an electric oven at 105° C. for the soil samples and at 70° C. in respect of plant samples.

An examination of the data presented graphically in Fig. 1, indicates that the drought resistant varieties (*Mtu.* 17 and *W.* 418) maintained higher moisture potential in their tissues than the susceptible types (*Co.* 13 and *B.* 76) with increasing moisture stress of the soil. Further, the decrease in moisture content of the plant with increasing moisture stress of the soil was more pronounced in the susceptible varieties than in the resistant ones. Stocker (1961) considered restriction of water loss and maintenance of normal physiological function under moisture stress to be the main mechanism of drought resistance in plants. The present study is also suggestive that, in rice, one of the factors associated with drought resistance is the ability of the plants to retain high moisture potential in their tissue under drought conditions. This might possibly be deemed as one

of the criteria to screen drought resistant varieties from others.
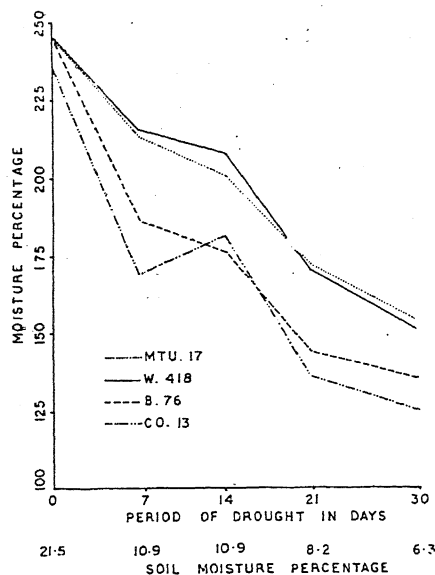
FIG. 1. Percentage of moisture on dry weight basis in shoot of different rice varieties under increasing soil moisture stress of soil.

Thanks are due to the Director, Central Rice Research Institute, Cuttack, for the facilities in the present investigation.

Central Rice Research   D. P. BHATTACHARJEE.
     Institute,   S. C. PAUL.
Cuttack-6, *October* 6, 1966.

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A FOSSIL LAGENIDIALEAN FUNGUS FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAON-KALAN, MADHYA PRADESH

AMONGST the rich variety of hitherto known plant fossils constituting the Deccan Inter-trappean flora, fungi are rather poorly represented. Two fungal perithecia, named as *Perisporiacites varians* and *Palæosordaria lagena*, and some dispersed fungal spores were described from Sausar by Sahni and Rao[1] in 1943. Traces of septate mycelium were also recorded by Sahni[2] in the seed of *Enigmocarpon*. Some septate hyphæ with (sic) spores similar to those of the Mucorales were recovered by Chitaley[3] in 1950 from a maceration of the Mohgaon chert. Comparatively recently a fossil rust infecting the fruit of *Enigmocarpon parijai* has been described by Dwivedi[4] under the generic name *Shuklania*.

While examining a thin ground section of a piece of chert from Mohgaon-kalan (22° 1′ N.; 79° 11′ E.), district Chhindwara, Madhya Pradesh, we have come across some small globular structures (Fig. 1) inside the general

FIG. 1, × 700

tissue of the basal region of a *Sahnipushpam* flower. On closer examination these globular bodies appear to be fungal sporangia strongly reminiscent of the Lagenidiales. The sporangia are more or less rounded, about 12–15 μ across, thin-walled and devoid of any recognizable contents. At places the adjacent sporangia are clearly seen as interconnected, indicating their origin from a filamentous structure by constriction or septation and subsequent development into the typical globose structures usually found in the Lagenidiales.

Though these sporangia-like bodies are so very suggestive of Lagenidialean affinities, yet in the absence of any zoospores it is impossible to ascribe them definitely to any genus. Lagenidiales are well known as aquatic fungi. It is quite probable that the fossil fungus reported herein, infected the *Sahnipushpam* flower while it was lying in water prior to silicification.

We are grateful to Professor F. K. Sparrow of the University of Michigan and Dr. J. N. Rai and Dr. B. B. Sharma of the University of

Lucknow for their kind suggestions and help in the identification of the present fossil.

Birbal Sahni Institute of   R. N. Lakhanpal.
         Palæobotany,   R. Dayal.
Lucknow,   R. K. Jain.
October 1, 1966.

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VERTEBRATE FOSSILS FROM DERA-GOPIPUR TEHSIL, DISTRICT KANGRA (PUNJAB)*

An area of about 120 sq. km. of Siwalik country lying between Dera-Gopipur (31° 53′ : 76° 13′) and Rani Tal (32° 00′ : 76° 14′) has yielded a rich assemblage of vertebrate fossils during the field season 1965-66. In all about 116 mammalin remains of different species have been found. The identification of the different finds is under way.

The stratigraphic sequence exposed in the area is tabulated in Table I. A few characteristic fossils are mentioned in the table.

and the Middle Siwalik with the Nagri and Dhok-Pathan of Sarmatian and Pontian ages respectively. The Middle Siwaliks of this area can be correlated with the fossiliferous beds of Haritalyangar[3] (31° 32′ : 76° 38′), Kot-Kahlur (31° 18′ : 76° 31′) and Aitham (32° 47′ : 76° 01′) in Jammu and Kashmir, where also the author has found for the first time some vertebrate fossils of Sarmatian and Pontian ages.

The author is much indebted to Shri. T. Banerjee, Superintending Geologist, for critically going through the manuscript and for valuable suggestions.

Directorate of Geology,   Uma Shanker Misra.
Oil and Natural
  Gas Commission,
Dehra Dun, *October* 24, 1966.

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TABLE I

Sub-group	Thickness in metres	Characteristic fossils	Horizon	Age	Equivalent time stratigraphic unit Europe
Upper Siwalik	735	No vertebrate fossil found	Pinjaur	Pliocene	Villafranchian
Middle Siwalik	354–650	*Mastodon (Tetralophodon punjabiensis), Hipparion theobaldi Giraffa punjabiensis, Boselaphus* sp., *Proleptobos* sp., *Tragoceros* sp., *Gazelia (?). Superba* Pilg.	Dhok-Pathan	Upper Miocene	Pontian
	734–935	*Driopithecus punjabicus* Pilg. *Stegolophodon cautleyi, Conohyus* sp.	Nagri	Middle Miocene	Sarmatian
Lower Siwalik	25– 46	*Trilophodon Chinjiensis, Tetralophodon* sp., *Amphicyon palœondicus, Aceratherium* sp., *Giraffokeryx* sp.	Chinji	do.	Upper Tortonian

The fossils from the Lower and Middle Siwalik of this area will be of great help in correlation of the different rock units. Systematic mapping of the Siwalik belt has shown that the rocks suffer from rapid facies changes which introduce difficulty in subdividing the individual rock units. The present find of the fossils from the Lower and Middle Siwalik rocks of Dera-Gopipur—Rani Tal area has proved the time-equivalence of the Lower Siwalik rocks of this area with the Chinji of upper Tortonian age,

ON SOME ASPECTS OF THE PRE-CAMBRIAN GEOLOGY OF PARTS OF THE SHILLONG PLATEAU, ASSAM*

The Shillong Plateau of Assam is a block of pre-Cambrians fringed by Cretaceous-Eocene shelf sediments. The pre-Cambrians comprise high grade metamorphics including granulites, amphibolites, gneisses and schists, and metasediments of the Shillong Series, besides several bodies of granite. This note attempts to highlight the implications of some recent remapping

of the Shillong Series in the central part of the Shillong Plateau by the author, which is leading to an interesting re-evaluation of the pre-Cambrian geology of the area.

Medlicott (1869, p. 44 ff.) described a sequence of sediments which he named the Shillong Series. He thought that these could be divided into an argillaceous facies below and an arenaceous facies above deposited "consecutively". At the junction of the two facies he described from various localities a conglomerate of consistent lithologic characters; he also thought that the rocks grade from a predominantly submetamorphic suite to strongly metamorphosed quartzites, schists and gneisses but he did not discuss the distinctions between this latter group and older rocks of his 'Gneiss Series". He described a group of porphyritic granites around Mylliem as intrusive into the Shillong Series. His classifications are retained in later literature though the "Gneiss Series" is now implicitly equated with the Archæans.

Present work shows that the conglomerate on the Masura ridge north of Barapani (25° 38′ 00″ : 91° 32′ 30″), hitherto taken as the junction of the argillites and the arenites of the Shillong Series represents a profound unconformity separating suites radically different in grades of metamorphism and styles of deformation. The strongly metamorphosed rocks below the conglomerate grade northwards into gneisses and granulites of the typical Archæans. Above the conglomerate the rocks are of the typically "submetamorphic" Shillong Series, including a group of current-bedded sandstones with minor shales (slate-phyllite). The Barapani-ridge provides a typical cross-section of the conglomerate basal to the Shillong Series. The high grade metamorphic rocks below the conglomerates, which indicate a marked unconformity, are now to be treated as forming a separate group.

The basal conglomerate is not developed everywhere; weakly metamorphosed sandstones of the Shillong Series as here defined may lie abruptly against strongly metamorphosed quartzites of the older group as seen at Mawmaram village on the road from Mawngup to Mairang; the foliation in the metamorphics may even parallel the bedding in the Shillong Series. In such cases delineation should be on contrasted metamorphism and it is necessary to distinguish between massive sandstones and massive metaquartzites. The Shillong Series sediments are post-orogenic epicontinental, ntly deposited in an intra-cratonic basin.

Within the metamorphics north of the Masura ridge occur a syn. to slightly late kinematic medium-grained granodiorite-adamellite-syenite-diorite body that has broadly concordant contacts with the metamorphics and shows very variable petrography, due to assimilation as well as granitization of various rocks. Its characteristics—gneissose borders, besides xenoliths all of high metamorphic grade—are consistent with a "parautochthonous" emplacement. These granitic rocks, well exposed on the Um Ran stream near the 41st milestone on the Gauhati-Shillong Highway, will be called the Um Ran Pluton. Later than this is a porphyritic granite of the typical Mylliem type, very well seen near Nongpoh on the same highway; this type, later than the culminating metamorphism, is the better known and is associated in many areas with the non-porphyritic type. The occurrence of these associated granites all across Assam and the universal presence in these of weakly perthitic microcline rather than orthoclase as the only potash feldspar phase suggest that these are all mesozonal. This casts doubts on the current view that these granites are intrusive into the Shillong Series—a view clearly based on Medlicott's opinion of varying metamorphism referred to above. The relationship between the granites and the Shillong Series as here separated, will have to be studied.

Geol. Survey of India,   Sujit Kumar Mazumder.
Assam Circle, *October* 12, 1966.

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OCCURRENCE OF *STIGMATOGOBIUS ROMERI* (M. WEBER) IN RIVER NARBADA

Stigmatogobius romeri (M. Weber) has so far been recorded only from islands like Andamans, Java, etc.[1-2] In December 1965, in the course of a survey of river Narbada seven specimens of this species ranging from 31·5 mm. to 42·0 mm. total length were collected from freshwater, six at Targhat and one at Fatheghat on Narbada (Hoshangabad District, Madhya Pradesh). This is the first record of this species from mainland of India.

This species has been described in detail by Mukerji[3] and Koumans[1-2]; the latter has done much in bringing out the synonymy involved. A comparison of these specimens from the

Narbada with the specimens from Andamans which are in the collection of the Zoological Survey of India, Indian Museum, Calcutta, does not reveal any significant differences between them. One variation noticed is that whereas the interorbital pores in the specimens from Andamans are indistinct,[1,2] they are quite distinct in the specimens from Narbada. The ventral fins are oval in the specimens from both the localities, although Koumans[1,2] stated that they are rounded in the specimens from Andamans. According to Koumans, the maxilla in this species extends to behind eye in males and to middle of eye in females; in the Narbada specimens, however, the maxilla extends only to below posterior third of eye in males and to below anterior third of eye in females. The scales before ventral fins are imbedded in the skin which can only be observed when a piece of the skin is examined under a binocular microscope. However, in the absence of any significant differences in the body proportions, meristic characters and colouration, the Narbada specimens cannot be treated as a separate subspecies in spite of the geographical separation.

I am grateful to Dr. A. P. Kapur, Director, Zoological Survey of India, for kindly sending me the specimens of *S. romeri* (*S. neglectus*) from Andamans for examination.

Central Regional Station,   V. Visweswara Rao.
Zoological Survey of India,
Jabalpur, *November* 23, 1966.

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BACTERIAL BLIGHT DISEASE OF *CYNODON DACTYLON* PERS.

Cynodon dactylon, a perennial grass commonly known as Hariali, is extensively used as green fodder for cattle in Western India. A bacterial disease which is systemic in the vascular strands was noticed during the rainy seasons of 1963-66 in South Gujarat. The disease is easy to recognise, since by sectioning the infected portions, the bacterial ooze from the vascular strands becomes quite conspicuous.

The disease first appears as water-soaked, translucent, linear, pale yelow to dark green streaks, running parallel to the leaf veins or along the midrib of the lamina. When the infection is heavy, several streaks coalesce and

develop into brown, translucent lesions measuring about 1 cm. long.

Isolation of the disease-inciting pathogen was done by both the streaking and the dilution poured plate techniques using potato dextrose agar medium. Inoculation experiments were carried out on both the young and mature plants of *Cynodon dactylon*. Typical disease symptoms were obtained, and the bacterium reisolated from the artificially inoculated leaves corresponded in all its characters with the pathogen isolated from the natural lesions. Cross-inoculation experiments carried out on *Eleusine coracana* Gaertn, *Oryza sativa* L., *Panicum miliaceum* L., *Paspalum scrobiculatum* L., *Sorghum vulgare* (L.) Pers., *Setaria italica* Beauv., *Pennisetum typhoideum* Rich., *Zea mays* L., *Triticum œstivum* L., *Hordeum vulgare* L., and *Avena sativa* L., showed that these were not susceptible. The morphological, cultural and physiological characters of the pathogen undoubtedly place it in the genus *Xanthomonas*. The pathogen under study differs from *Xanthomonas translucens* in its host range and a few biochemical characters. It is, therefore, proposed to name the pathogen as *Xanthomonas cynodontis* nov. sp., whose technical description is as follows:

Short rods with rounded ends, usually single, occasionally in pairs, measuring $1 \cdot 1–1 \cdot 8 \times 0 \cdot 5–0 \cdot 7$ microns, motile by a polar flagellum, Gram-negative, encapsulated, no endospore and non-acid-fast. Colonies on potato dextrose agar plates are circular with entire margin, smooth, pulvinate, butyrous and glistening yellow. Growth on potato dextrose agar slants is abundant, filiform, convex, glistening, smooth, opaque, butyrous and lemon yellow; medium unchanged. On nutrient agar slants, growth is moderate, filiform, convex, glistening, smooth, opaque, butyrous and lemon yellow; medium unchanged.

Gelatin liquefied, starch hydrolysed, casein digested, tributyrin and several other fats hydrolysed, milk peptonised and litmus reduced; ammonia and hydrogen sulphide produced from peptone; nitrates not reduced to nitrites; indol not produced; V.P. and M.R. tests negative; citrates utilised but not uric acid; tolerates 3% sodium chloride; acid without gas from arabinose, xylose, glucose, fructose, galactose, mannose, lactose, maltose, sucrose, cellobiose, glycogen, dextrin, and mannitol but not from rhamnose, inulin, salicin, sorbitol, dulcitol, and inositol. Seventeen amino-acids supported growth as source of nitrogen while DL-serine, DL-nor-leucine and L-tyrosine failed to do so.

Letters to the Editor

DL-alanine, L-glutamic acid, L-proline and L-hydroxy-proline supported growth while sixteen other amino-acids failed to support growth as source of carbon. Catalase positive ; facultative aerobe ; optimum temperature for growth 27–30° C ; thermal death-point 53° C.

Pathogenic to *Cynodon dactylon* only, producing blight on leaves ; found at several places in South Gujarat.

B.P. Baria Science   S. G. Desai.
                 Institute,   M. K. Patel.
Navsari,   A. B. Gandhi.
Gujarat, *October* 17, 1966.   W. V. Kotasthane.

EFFECT OF SOME ALIPHATIC ACIDS ON THE GERMINATION OF PEA POLLEN

During recent years, investigations regarding the effect of amino-acids, vitamins and growth harmones on pollen germination and pollen tube growth have received considerable attention.[1] The role of the aliphatic acids in these processes, however, has remained unexplored. We, therefore, tried to determine the effect of a few aliphatic acids on the germination and tube length of the pollen grains of pea (*Pisum sativum* L.).

TABLE I

*Showing the germination percentage and pollen tube length in sugar-agar medium supplied with varying concentrations of different acids**

Acids used		Concentrations of acids used			
		0·001%	0·002%	0·003%	0·005%
Citric	.. *a*	48	40	27	18
	b	320	400	560	64
Malic	.. *a*	49	50	45	20
	b	240	240	288	480
Tartaric	.. *a*	75	71	42	21
		240	560	480	112
Amino-acetic	.. *a*	83	90	78	70
	b	320	480	400	400
Oxalic	.. *a*	92	71	42	22
	b	320	640	720	320
Control†	..	*a* 78			
		b 240			

a = average percentage of pollen germination, *b* = average pollen tube length in microns.

* Experiments were performed at room temperature (21°–23° C.).   † Control medium consisted of 27·5% sucrose + 1% agar in redistilled water.

The data, presented in Table I, clearly indicate that three of the five acids, *viz.*, Citric, Tartaric and Malic appear to inhibit pollen germination even in minute concentrations, whereas, Oxalic and Amino-acetic acids accelerate germination when present in very low concentrations (0·001% or up to 0·002%). The latter also inhibit it in higher concentrations. One particularly noteworthy feature of this study is that though these aliphatic acids are inhibitory to pollen germination, they greatly enhance the pollen tube growth. The pollen tubes are about three times longer in the medium containing 0·003% oxalic acid than the pollen tubes formed in the basic control medium.

Dept of Botany,   B. S. Trivedi.
Univ. of Lucknow, Prakash Chandra Sharma.
Lucknow (India), *October* 18, 1966.

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EFFECT OF FUSARIC ACID ON *IN VITRO* CULTURE OF EMBRYOS OF *PHASEOLUS VULGARIS* L.

The study of plant toxins is gaining importance as a tool in unravelling the host-parasite relationships in phytopathology. The toxins of fungal origin are of special interest since a large number of plant diseases are caused by fungi. Fusaric acid (FA) is a toxin of known chemical structure produced by species of *Fusarium* and *Gibberella*. It is known to be a non-specific toxin interfering with the chelation of heavy metals like iron and copper and affecting the water permeability of the host protoplasts (Tamari and Kaji, 1954 ; Gäumann, 1958). It was thought that a study of its action on meristematic plant tissues grown in sterile culture would yield useful results. A preliminary study was made on embryos of *Phaseolus vulgaris* grown on Nitsch's (1951) basal medium supplemented with vitamins (NBV). FA was added to the basal medium in concentrations of 0·25 mg./l. ; 0·75 mg/l. and 1 mg./l: The pH was adjusted to 5·6. Embryos were selected from mature green pods and planted in the medium after the removal of cotyledons. Controls were grown without the addition of FA.

The embryonal axes grown on medium containing 0·25 mg./l. of FA increased in size on the fifth day after inoculation and the root and shoot meristems started functioning. The hypocotyl indicated normal growth and elongation. However, fifteen days after inoculation the lower part of the hypocotyl started callusing (Fig. 1). After 35 days' growth the first pair of leaves failed to enlarge whereas controls developed plantlets with 3 or 4 nodes (Fig. 4)

in the same period. The shoot bud wilted and dried up after 40 days and the roots were not numerous. Cultures grown with the addition of 0·5 mg./l. of FA exhibited a more or less similar course of development. Concentrations of 0·75 mg./l. and 1 mg./l. inhibited the growth of shoot buds very early. In these cases the embryos indicated a stunted shoot bud. However, the hypocotyl enlarged and its lower end was ruptured due to the development of roots. In about ten per cent of the cultures grown on 1 mg./l. concentration of FA the first leaves of the epicotyl expanded but ultimately wilted and dried up. The root system in such cases was not well developed and the rootlets were not produced (Fig. 3).
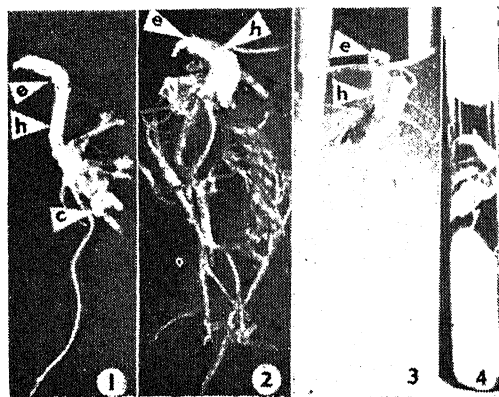
FIGS. 1–4. Fig. 1. 15-day-old embryo axis of *P. vulgaris* grown on medium containing 0·25 mg./l. of FA, × 1. Fig. 2. Embryo axis grown on medium containing 0·75 mg./l. of FA, × 1. Fig. 3. Wilting of leaf in culture grown with the addition of 1 mg./l. of FA, × 1. Fig. 4. Control grown on NBV without the addition of FA, × ⅓. *h*–Hypocotyl; *e*–Epicotyl; *L*–Wilted leaf.

The results of this study indicate that in low concentrations FA induces callus formation while at higher concentrations the marked effect was inhibition of shoot growth. The wilting of the first leaves produced by a small percentage of cultures is associated with the scanty development of rootlets and hence the slow movement of FA into the shoot. But when the roots elongate FA may be transported to the leaves which ultimately wilt and dry up.

I am grateful to Professor T. S. Sadasivan for facilities and encouragement.

University Botany Lab.,
Chepauk, Madras-5 (India),   D. PADMANABHAN.
     December 3, 1966.

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A NOTE ON CYCOCEL (2-CHLOROETHYL TRIMETHYL AMMONIUM CHLORIDE), A NEWLY RELEASED PLANT GROWTH REGULANT

CYCOCEL, a newly released plant growth regulant, is indicated to produce unusual and varied responses on a wide range of plant species. The nature and behaviour of this growth regulant and its possible applications in crop production are yet to be fully evaluated. Hence it was of interest to study the effects of this chemical on plant growth and development using beans (*Phaseolus vulgaris*) as the test plant.

Effect of Cycocel on Germination of Seeds and Rooting.—Fifty bean seeds were placed on paper towels completely wetted with 100 p.p.m. of cycocel solution, for germination. This facilitated continuous contact of seeds with the chemical throughout their period of germination and rooting. Simultaneously placed bean seeds on paper towels wetted with distilled water provided the needed controls for comparisons to be made. Observations made revealed that cycocel does not affect (*a*) germination, (*b*) rooting and (*c*) formation of root hairs. However, elongation or extension of top and lateral roots was considerably reduced. Profuse formation of laterals and their early initiation in seeds germinating on paper towels soaked with cycocel were noteworthy. Since seeds germinated and roots were initiated, it is reasonable to assume that the chemical does not affect early cell division, multiplication and differentiation. The early initiation of laterals and thickening of roots probably reflect acceleration of differentiation and maturation of cells and tissues in roots. The effect of cycocel on length of roots and number of laterals produced is summarised in Table I.

TABLE I

Treatments	Length of tap roots (in cm.)	Length of laterals (in cm.)		No. of lateral roots present
		Max.	Min.	
Cycocel ..	4·6	3·8	1·1	2
Control ..	9·8	4·4	1·5	7

Note : The data represent one taken on 5th day after commencement of the experiment and an average from 56 germinated seeds in each case.

Effect of Cycocel on Emergence, Early Growth and Development of Seedlings.—Wooden flats of 18″ × 13″ × 3½″ filled with approximately ¼th c.ft. of potmixture were treated with 250 ml. of 5000 p.p.m. of cycocel, applied as a soil surface

spray, per flat. Following applications of the chemical, 25 bean seeds were sown per flat. Non-treated controls were provided. Watering was done once a day throughout the experiment to provide the adequate moisture needed for germination of seeds and growth of seedlings. The experiment was terminated when the first pair of leaves were fully expanded.

Observations made revealed that soil applications of cycocel produced short, stocky, heavier plants with large sized leaves and compact root system (Photograph 1). Some of the
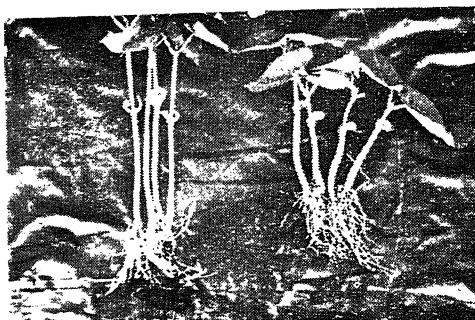
PHOTOGRAPH 1. *Left*: Control. *Right*: Cycocel-treated.

Note:—Application of cycocel results in short, stocky plants with a compact root system and large leaves. Note the thickening of basal part of stems and reduction in length of epicotyl and hypocotyl portions of stems. Photograph of bean seedlings taken 10th day after commencement of experiment. Cycocel was applied to soil at the time of seedling.

growth measurements, that were significantly influenced by cycocel, are tabulated below:

TABLE II

	Growth measurements made	Cycocel	Control
1.	Height of plant (in cm.) ..	9·2	14·7
2.	Length of leaf (,,) ..	5·5	3·9
3.	Width of leaf (,,) ..	5·4	3·8
4.	Length of petiole (,,) ..	1·7	2·0
5.	Fresh weight of leaf (in mg.) ..	498·0	258·0
6.	Fresh weight of plant (in gm.) ..	2·271	2·122

Data represent one taken on 10th day after commencement of experiment, and an average from 25 seedlings selected at random for each treatment.

It was also interesting to note that in many of the seedlings, the stem portion below the cotyledons (hypocotyl portion) was considerably thick with increased diameter as compared to controls. If cycocel as in the case of beans could produce similar responses in common vegetables and ornamentals, it could be applied to nursery beds at the time of seeding.

While growth regulants like mallic hydrazide (MH) could completely inhibit vegetative growth and gibberellins could act as a general growth promoter it is rather interesting to note that cycocel behaves in somewhat an unusual manner. On the one hand it has inhibited the elongation of main stem and tap root but on the other hand has contributed to increase in size of leaves and diameter of stems. Even with regard to leaves while cycocel has increased expansion of leaf blades, it has reduced the length of petioles. The selective responses of plant parts and tissues to cycocel deserve attention.

Lal-Bagh, Bangalore,   D. S. LINGARAJ.
October 5, 1966.   K. M. SRINIVASAN.

A NEW APHID HOST OF *APHELINUS MALI* (HALDEMAN) IN INDIA*

THE Eulophid parasite, *Aphelinus mali* (Haldeman), was originally introduced into India from England in 1937 to control the woolly aphid, *Eriosoma lanigerum* (Hausmann), in the Punjab (Rahman and Wahid Khan, 1942). Later, it was also released in the Pomological Garden, Coonoor, Madras State, for the same purpose (Cherian, 1942). In both areas the parasite became well established within a short time. So far, there appears to be no record of the parasite attacking any other host in India. In March 1964 small colonies of *Aphis gossypii* Glover were found infesting the weeds *Bacopa monnieri* (L.) Pennel (Scrophulariaceæ) and *Rotala leptopetala* Koehn. (Lythraceæ) in some localities at Bangalore. Some of the aphids were found to be parasitized. *A. mali* was obtained from aphids on *B. monnieri* and another *Aphelinus* sp. from aphids on both the weeds. The present record of another aphid host of *A. mali* is interesting. It shows that the parasite is no longer restricted to *E. lanigerum* or to the localities in India where it was released to control this pest. Rahman and Wahid Khan (1942) offered 13 other aphids (which did not include *Aphis gossypii*) to *A. mali* for oviposition but none was accepted. Thompson (1953) has listed *Aphelinus gossypii* Timb., *A. semiflavus* How. and *A. varipes* Först. as parasites

of *Aphis gossypii*. *A. mali* is known to attack several other aphids and also some coccids (Muesebeck *et al.*, 1951; Thompson, 1953; Peck, 1963). However, all these records are from outside India.

The author is indebted to Dr. V. P. Rao, Entomologist-in-charge, CIBC Indian Station, for his interest in this work. He is grateful to Dr. B. D. Burks for identifying the parasites through the good offices of Dr. W. H. Anderson, Chief, Insect Identification and Parasite Intro-duction Research Branch, U.S. Department of Agriculture, Beltsville, and to Dr. S. Kanakaraj David, Department of Zoology, Christian College, Madras, for identifying the aphid.

Commonwealth Institute of T. SANKARAN.
  Biological Control,
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A NOTE ON THE INTERSPECIFIC CROSS BETWEEN *HIBISCUS SABDARIFFA* L. AND *H. CANNABINUS* L.

THE species *Hibiscus sabdariffa* L. ($2n = 72$) and *H. cannabinus* L. ($2n = 36$) are cultivated in South-East Asia chiefly for fibre, as a jute substitute. With a view to obtain a plant possessing the desirable characters of *H. sabdariffa* (fine fibre quality, and fleshy calyx), and *H. cannabinus* (earliness, resistance to *Phytophthora* and long fibre), an interspecific cross was attempted between these species. Since these species do not cross by normal methods, the grafting technique of Iyer *et al.* (1961) used in the interspecific hybridization of *Corchorous* was adopted. The species *H. sabdariffa* and *H. cannabinus* were grafted one over the other by "approach graft" method. The grafting was successful and the 'Xenoplastic' graft grew normally. The graft with *H. cannabinus* as the root-stock, and *H. sabdariffa* as scion grew to maturity and produced flowers, whereas the grafts of *H. cannabinus* on the root-stock of *H. sabdariffa* succumbed to

wilt due to the susceptibility of the root-stock (*H. sabdariffa*) to the disease.

Crosses were made using *H. sabdariffa* (scion) as the female parent and *H. cannabinus* as the male parent. The fruits developed normally, but dehisced in about 20 days after pollination. When the seeds were examined they were found to be shrivelled with no contents inside.

The non-crossability of these species appears to be due to both physiological and genetical reasons. By grafting, the physiological barrier was overcome and thus resulted in the development of fruit. This is evident, because there was no fruit formation when these species were crossed without grafting. The failure to set seed may be due to the difference in the chromosome number. Doubling of the chromosomes of *H. cannabinus* and crossing it with *H. sabdariffa* by adopting the grafting technique then, may facilitate successful crossing of these species.

The author is grateful to Dr. S. W. Mensinkai, College of Agriculture, Dharwar, for his keen interest and facilities.

Cytogenetics Laboratory, P. S. REDDY.
Botany Section,
College of Agriculture,
Poona-5, *November* 26, 1966.

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INTROGRESSION IN *SACCHARUM*

THE genus *Saccharum* consisting of 6 species, namely, *S. officinarum*, *S. robustum*, *S. spontaneum*, *S. edule*, *S. sinense* and *S. barberi* and its related genera such as *Erianthus, Narenga, Sclerostachya, Miscanthus*, etc., are of importance in genetics and breeding of sugarcane. *S. spontaneum* occurs in West, Central and South East Asia, Malayasia, and Polynesian and Melanesian islands, *S. barberi* in North India and *S. sinense* in South East Asia and southern Japan. At the Sugarcane Breeding Institute, there is a germ plasm bank where most of these genera and species are maintained in a live herbarium. Hence an experiment laid out to study the effect of introgression of these related species into *S. officinarum*, the noble cane known for its high sucrose content. Some of the observations recorded are reported in this note.

Fifty-six clones of six species of the genus *Saccharum* mentioned above (16 clones of *S. spontaneum*, 12 of *S. robustum*, 9 of *S. officinarum*, 9 of *S. barberi*, 8 of *S. sinense* and 2 of *S. edule*) representing most of the

chromosome numbers known to occur ($2n = 48$ to 164) and from all areas of geographical distribution were selected. Healthy clones were taken, cut into three budded setts and planted in twenty feet rows with a distance of three feet between the rows. Three genotypes were planted in each row in 5 ft. distance with $2\frac{1}{2}$ ft. distance between the genotypes. The experiment was laid out in a randomised complete block design with 2 replications. Observations were recorded when the crop was eleven months old on the following characters : (1) Plant height, (2) Leaf length, (3) Leaf width, (4) Brix and (5) Stalk girth. Data were collected for two tallest healthy stalks per genotype in each replication in 48 genotypes. Correlations between the mean values with respect to brix, stalk girth and leaf-width were studied. The data indicated that there were highly significant positive correlations between brix and stalk girth ($0 \cdot 61^{**}$), brix and leaf width ($0 \cdot 45^{**}$) and stalk girth and leaf width ($0 \cdot 79^{**}$). Pictorialized scatter diagram of these data is given in Fig. 1.
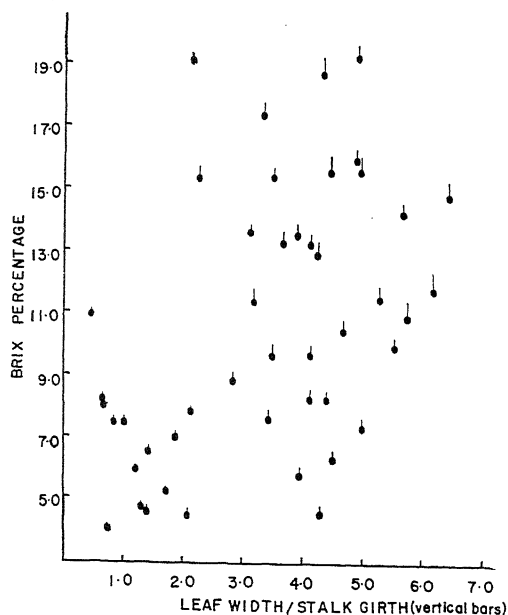
FIG. 1.

Observations were recorded one and a half month later on brix and these data also indicate highly significant correlations between brix and stalk girth and brix and leaf width.

Grassl[1] has reported that *S. officinarum* has been modified to a considerable extent by introgression of characters from *Miscanthus floridulus* and in extreme cases brought about cenanthy in the former. He also believes that intro-

gression of characters from the same species to *S. robustum* has been extensive in the highlands of New Guinea. Though the data are limited, the existence of great restriction of recombinations and the fact that the points in the pictorialized scatter diagram fall along a broad line (for details see Anderson[2]) in the present study, indicate that introgressive hybridization seems to have played a role in enriching the variability and great amount of genetic heterogeneity in *Saccharum* species.

Sugarcane Breeding   D. JAGATHESAN.
       Institute,   M. R. VENKATARAMAN.
Coimbatore-7,   S. S. SHAH.
October 27, 1966.

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INDUCTION OF HETEROCYSTS IN THE BLUE-GREEN ALGA *ANABAENA AMBIGUA*

HETEROCYSTS are specialized cells found in some blue-green algæ whose function is little understood. Some vegetative cells present in a filament at more or less definite places, develop into heterocysts. The factors that control this process of cellular differentiation are not clear. We have developed a simple technique by which heterocyst formation can be brought about within a short time. It is based on some observations of the earlier workers[1,2] who showed that ammonium ions suppress the development of heterocysts in a number of blue-green algæ.

The alga used in the present investigation *Anabæna ambigua* (Cambridge Culture Collection 1403/7) is grown in Allen and Arnon's medium[3] supplemented with ammonium chloride, 20–30 mg. per 100 ml. When grown in this medium it forms very long and undifferentiated filaments devoid of heterocysts (Fig. 1). These filaments after 7–10 days growth, are centrifuged aseptically, washed once and resuspended in the sterile Allen and Arnon's medium (without ammonium chloride) and kept near a fluorescent tube lamp, 40 W, at a distance of 150 cm. After approximately 48 hrs. well-developed heterocysts could be seen in all the filaments (Fig. 2). However,

the incipient heterocysts could be recognized even within 10–12 hrs. of the induction period by visual inspection and also confirmed by the staining techniques for polyphosphates.[4] The earliest stage in the development of the heterocyst could be identified by the absence of polyphosphate granules in the developing cell.[5]

washed and resuspended in the medium free of antibiotic heterocysts developed promptly within 24 hrs. It appears that protein synthesis is necessary for the differentiation of heterocysts. We also observed that light was essential for the formation of heterocysts and could not be replaced with glucose. Efforts are being made to identify the specific steps involved and the
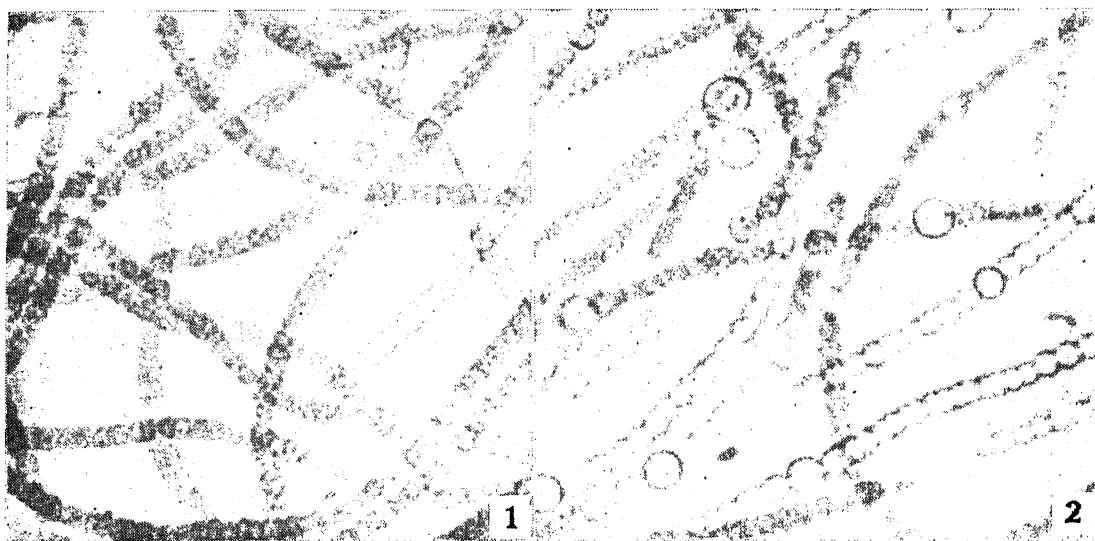
FIGS. 1–2. Fig. 1. *Anabæna ambigua* grown in AA medium supplemented with ammonium chloride 20 mg. per 100 ml., 20 days old. Fig. 2. Same after resuspending in AA medium alone, incubated in light for 24 hrs.

Using the above method we propose to tackle the problems connected with the cellular differentiation in heterocystous blue-green algæ, for example various factors that control the formation of heterocysts. We assume that this process involves several enzymes whose production and/or activity is controlled by ammonium ions. Some of these are likely the enzymes responsible for the loss of polyphosphates from the incipient heterocyst[5] and also the enzymes connected with the synthesis of cellulose found in the heterocyst wall. The induction of these enzymes during the development of heterocyst and its control can be studied by the use of inhibitors specific for the different steps in protein synthesis. In a preliminary study we found that a well-known inhibitor of protein synthesis, chloramphenicol (CP) at a concentration of 2·5 μg per ml. in Allen and Arnon's medium completely suppressed the formation of heterocysts. This effect was found to be reversible, *i.e.*, when the material previously exposed to CP (100 μg per ml.) for 48 hrs.,

enzymes concerned in the induction and formation of heterocysts.

Department of Botany,   E. R. S. TALPASAYI.
Banaras Hindu University, KM. SHANTA KALE.
Varanasi-5, *November* 29, 1966.

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CYTOLOGICAL BEHAVIOUR OF A SEMI-POLLEN-STERILE PLANT OF *VICIA FABA*

DURING the course of our attempts to isolate male sterile plants in leguminous crops, a semi-pollen-sterile plant was found growing in a bulked culture of *Vicia faba*. Examination of the pollen mother cells of this plant was made to ascertain the causes of sterility.

Young inflorescences of the plant were fixed in acetic acid-ethanol (1 : 3) for 24 hours and stored in 70% ethanol till further use. 0·5% acetocarmine was used for the preparation of squashes. Slides were made permanent through Normal-Butyl-Alcohol series.

Meiosis in some microspore mother cells proceeds normally to form quartets, which further undergo simultaneous type of wall formation to form tetrahedral microspore tetrads. But there were many others, which displayed various types of irregularities during both hetero and homotypic divisions. Multiple chromosome associations were frequent at prophase stage (Fig. 1). Metaphases were rather indistinct, as the chromosomes appeared sticky and therefore could not be separated clearly. Anaphase I was characterised by the formation of bridges and laggards (Fig. 2). After the chromosomes had reached the poles and entered telophase, cytokinesis occurred in some cells resulting in the formation of dyads (Fig. 3). The nuclei of the cells constituting the dyads did not divide at all and evidently the chromatid separation never occurred in such cases. In other microspore mother cells, where cytokinesis did not follow heterotypic nuclear division, the nuclei entered the second division. Chromatin bridges (Fig. 4) and laggards were very prominent during the second division also. Laggards subsequently got transformed into micronuclei, which were either included within one of the four microspores produced after cytokinesis or delimited as separate cells. In the latter case polyspory ensued (Fig. 5).

Multivalent formation at prophase, followed by the development of chromatin bridges and laggards at the first and second anaphase stages together with considerable reduction in pollen fertility, are features suggestive of either structural heterozygosity or stickiness of chromosomes.

In deciding the possible nature of the *Vicia faba* plant under discussion, one is more drawn to accept the second alternative. This is because the development of bridges and laggards speak of the heterozygosity for one or more paracentric
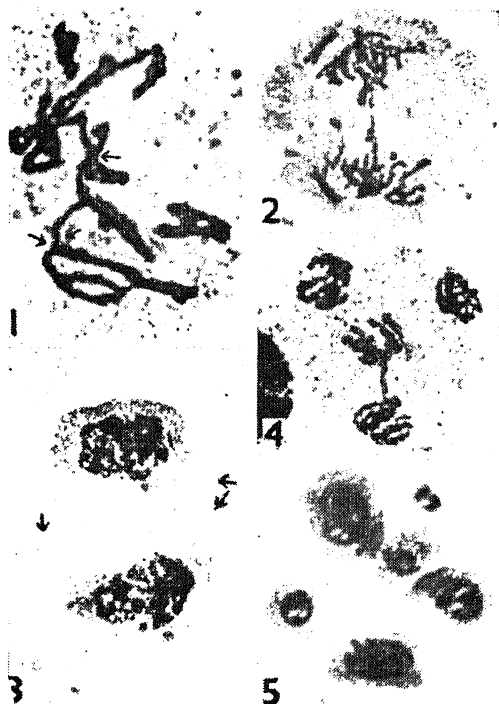
FIGS. 1-5. Fig. 1. Prophase I showing multiple chromosome associations. Fig. 2. Anaphase I showing a bridge and laggards. Fig. 3. Dyad formation (Arrows indicate the outline of dyad cell walls). Fig. 4. Telophase II showing a bridge. Fig. 5. A polysporad.

inversions. But in that case prophase stage would be characterized by the development of loops rather than multivalents. The formation of multivalents and also the presence of chromatin bridges can well be explained if the plant be considered to bear the gene that brings about stickiness. Such a gene has earlier been reported in maize by Beadle.[1]

Department of Botany,   C. L. KAUL.
B.R. College, Bichpuri,   S. P. SINGH.
Agra, *October* 15, 1966.

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REVIEWS AND NOTICES OF BOOKS

The Harvey Lectures, Series 60 (1964-65). (Academic Press, Inc., New York and London), 1966. Pp. xiv + 314. Price $ 9.50.

The book contains the lectures delivered under the auspices of the Harvey Society of New York, and under the patronage of the New York Academy of Medicine.

The titles of the lectures contained in this book are : The Immune Response to a Simple Antigenic Determinant, by Herman N. Eisen; The Biological Significance of Uric Acid, by Alexander B. Gutman ; Biosynthesis of the Sympathetic Neurotransmitter, Norepinephrine, by Sidney Udenfriend ; The Fine Structure of Striated Muscle and Its Functional Significance, by Hugh E. Huxley ; Biochemical Aspects of Metamorphosis : Transition from Ammonotelism to Ureotelism, by Philip P. Cohen ; The Comparative Anatomy of a Gene, by S. E. Luria ; The Emperor's New Clothes, or an Inquiry into the Present Status of Tumor Viruses and Virus Tumors, by Hilary Koprowski ; The Nerve Growth Factor : Its Mode of Action on Sensory and Sympathetic Nerve Cells, by Rita Levi-Montalcini ; Gluconeogenesis : Pathways and Hormonal Regulation, by Henry A. Lardy.

C. V. R.

Handbook of Physical Constants. Edited by Sydney P. Clark, Jr. (Memoir 97). (The Geological Society of America), 1966. Pp. vii + 587. Price $ 8.75.

The scope of this book is indicated by the list of sections given below : 1. Composition of rocks, by S. P. Clark, Jr. ; 2. Abundances of the elements, by A. G. W. Cameron ; 3. Isotopic abundances and 1961 atomic weights, by S. P. Clark, Jr. ; 4. Density of rocks, by R. A. Daly, G. E. Manger, and S. P. Clark, Jr. ; 5. X-ray crystallographic data, densities, and molar volumes of minerals, by R. A. Robie, P. M. Bethke, M. S. Toulmin, and J. L. Edwards ; 6. Thermal expansion, by B. J. Skinner ; 7. Compressibility ; elastic constants, by Francis Birch ; 8. Internal friction in rocks, by J. J. Bradley and A. N. Fort, Jr. ; 9. Seismic velocities, by Frank Press ; 10. Geodetic data, by G. J. F. MacDonald ; 11. Strength and ductility, by John Handin ; 12. Viscosity, by S. P. Clark, Jr. ; 13. Melting and transformation points in oxide and silicate systems at low pressure, by F. C. Kracek and S. P. Clark, Jr. ;

14. Phase relations in sulfide-type systems, by G. Kullerud ; 15. High-pressure phase equilibria, by S. P. Clark, Jr. ; 16. Pressure-volume-temperature and phase relations of water and carbon dioxide, by G. C. Kennedy and W. T. Holser ; 17. Binary mixtures of volatile components, by H. J. Greenwood and H. L. Barnes ; 18. Ionization constants in aqueous solutions, by H. L. Barnes and H. C. Helgeson ; 19. Solubility, by S. P. Clark, Jr. ; 20. Thermodynamic properties of minerals, by R. A. Robie ; 21. Thermal conductivity, by S. P. Clark, Jr. ; 22. Heat flow and volcanic temperatures, by W. H. K. Lee and S. P. Clark, Jr. ; 23. Radioactive decay constants and energies, by G. W. Wetherill ; 24. Abundances of uranium, thorium, and potassium, by S. P. Clark, Jr., Z. E. Peterman and K. S. Heier ; 25. Magnetic properties of rocks and Minerals, by D. H. Lindsley, G. E. Andreasen, and J. R. Balsley ; 26. Electrical properties of rocks and minerals, by G. V. Keller ; 27. Conversion factors, numerical constants, atomic constants, by S. P. Clark, Jr.

C. V. R.

Research Program Effectiveness. Edited by M. C. Yovits, D. M. Gilford, R. H. Wilcox, E. Staveley and H. D. Lerner. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Pp. xvii + 542. Price : Professional edition $ 10.00 ; Reference edition $ 29.50.

This book represents the Proceedings of the Conference sponsored by the Office of Naval Research, Washington, D.C., held from July 27 to 29, 1965.

The contents of the volume are : Management of Interface Problems between Basic and Applied Research, by J. E. Goldman and L. M. McKenzie ; Project Selection in Industrial R and D : Problems and Decision Processes, by R. G. Brandenburg ; State-of-the-Art Projection and Long-Range Planning of Applied Research, by F. Pardee ; Program Planning in a Science-Based Service Organisation, by W. A. Hahn and H. D. Pickering ; Questioning the Cost/ Effectiveness of the R and D Procurement Process, by E. B. Roberts ; Information Systems for the Test of Hyptheses Pertaining to the Theory of Research Management, by N. S. Prywes and M. Silver ; New Tools for Improving and Evaluating the Effectiveness of Research,

by I. H. Sher and E. Garfield; Evaluating Two Aspects of Quality in Research Program Effectiveness, by H. M. Vollmer; Specialized Versus Generalized Models in Research Budgeting, by R. L. Ackoff; A Graph Oriented Model for Research Management, by O. Morgenstern, R. W. Shephard, and H. Gradowski; On Stochastic Scheduling, by W. E. Hildenbrand; Stochastic Networks in Research Planning, by B. V. Dean; Optimal Real-Time Control of Research Funding, by A. Charnes and A. C. Stedry; Some Properties of Project Schedule Recovery Limits, by P. V. Norden; Proposal Generation and Evaluation Methods in Research and Exploratory Development, by B. Sobin and A. Proschan; Sources of Ideas and Their Effectiveness in Parallel R and D Projects, by T. J. Allen; Diffusion of Innovations Resulting from Research: Implications for Research Program Management, by A. Shapero; Feedbacks in Social Systems, by N. Rashevsky; Some Common Concepts and Tentative Findings from a Ten-Project Program of Research on R and D Management, by A. H. Rubenstein; The Role of the Research Administrator, by C. W. Churchman, C. F. Kruytbosch and P. Ratoosh; Organizational Factors in Project Performance, by D. G. Marquis and D. M. Straight, Jr.; Preconceptions and Reconceptions in the Administration of Science, by G. Gordon; Conflict and Performance in R and D Organizations: Some Preliminary Findings, by W. M. Evan; Behavior and Self-Identity of Federal Scientist-Administrators, by E. S. Uyeki.

                                                    C. V. R.

General Entomology for Agricultural Students. By H. L. Kulkarny. (Asia Publishing House), Pp. 292. Price Rs. 15·00.

The book has been prepared by an experienced teacher with the specific object of providing a hand-book on entomology for agricultural students preparing for the graduate examination. The material, covering the usual syllabus, has been carefully arranged, and all essential information has been neatly presented. The first half of the book is general dealing with anatomy, metamorphoses and growth, circulation, reproduction, respiratory and nervous systems of insects. The second half deals with classified groups of insects of agricultural importance. The book is amply illustrated.   A. S. G.

Experiments in General Chemisty. By C. N. R. Rao and U. C. Agarwala. [Affiliated East West Press, (Pt.) Ltd., C-57, Defence Colony, New Delhi-3], Pp. 292. Price Rs. 9·50.

This is a laboratory manual in which 45 simple experiments are described to illustrate the basic principles of chemistry. The selected experiments are such as can be set up within the modest budget of an ordinary undergraduate college. The price appears to be too high for the mimeographed get-up in close-spaced typing.   A. S. G.

Text-Books on Botany

An Introduction to Gymnospores. By S. C. Datta. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), Pp. 163. Price Rs. 12·00.

Structure and Reproduction of the Gymnospores. By B. S. Trivedi and D. K. Singh. (Shashidhar Malaviya Prakashan, 34, West Nayagaon, Lucknow), Pp. 185. Price Rs. 18·50. Authors' Copyright.

These two books written by teachers of the subject will form suitable text-books on gymnosperms for undergraduate and Honours students of botany. They include both living and fossil gymnosperms, and emphasis has been given to Indian types and work done in India on these types. There are descriptive chapters on Pteridospermæ, Cycadeoidales, Cycadales, Cordaitales, Ginkgoales, Coniferales, Gnetales, etc. The books are well illustrated and got up.   A. S. G.

Books Received

Thermodynamics Principles and Applications to Engineering. By Dr. Ing. Ernst Schmidt. (Translated from 3rd German Edition, by J. Kestin) (Dover Publications, Inc., New York), 1966. Pp. xx + 532. Price $ 3.00.

Transients in Power Systems. By H. A. Peterson. (Dover Publications, Inc., New York), 1966. Pp. xx + 532. Price $ 3.00.

Atomic Energy and Its Applications (2nd Edn.). By J. M. A. Lenihan (Sir Isac-Pitman & Sons, Pitman House, Parker St., Kingsway, London W.C. 2). Pp. xiii + 336. Price 45 *sh.*

Die Saugetiere Der Sowjetunion (Band I) Paarhufer und Unpaarhufer. By V. G. Heptner, A. A. Nasimovic und A. G. Bannikov. (VEB Gustav, Fischer Verlag, 69 Jena, Villengang), 939. Price MDN 163·20.

SOLAR CORONA*

THE solar corona is a spectacular feature of the Sun's outer envelope which manifests itself at total solar eclipse as a pearly white halo round the black disc of the moon. The recognition that the corona is a region of high temperature of the order of millions of degrees has enthused added interest during the past two decades in coronal research.

The 'atmosphere' of the sun, observationally as also theoretically, can be divided into three superincumbent layers, namely, the photosphere, the reversing layers, and the chromososphere in order of increasing level. The boundaries between these layers are only roughly defined, but broadly speaking the photosphere gives rise to the continuous spectrum, the reversing layers to the absorption or Fraunhofer spectrum, and the chromosphere to the bright line flash spectrum when seen during eclipses.

Mathematical analysis of the way in which the gaseous material comprising the outer layers of the sun may be expected to thin out into space, more or less justifies this threefold division. Thus a definite temperature gradient believed to exist in the photospheric layers shades off into an approximately isothermal state in the chromosphere. Again, the local thermodynamic equilibrium in the photospheric layers shades off into strict monochromatic radiative equilibrium in the chromosphere. The reversing layers play the role of transition layers exhibiting great complexity of structure and behaviour. Theory also predicts the chromosphere as a very delicately balanced structure, and the least departure from exact balance is followed by catastrophic consequences. Indeed, the abrupt changes of form, position and velocity shown by *prominences*—the tongues of flame which often flare out of the sun—are doubtless phenomena caused by this delicate imbalance.

The corona, as well as the prominences, are features that are displayed outside the conventional solar 'atmosphere'. The form of the corona varies considerably in a manner which is closely associated with the sunspot cycle. At sunspot maximum the corona appears as an approximately symmetrical glow round the sun extending from half to one solar radius from the photosphere ; but at sunspot minimum it displays long equatorial streamers extending to several solar radii, accompanied by polar plumes or tufts of light at the poles.

In the early years scientific study of the corona depended mostly on observations made during total eclipses of the sun, and by the turn of the century techniques of eclipse photography and eclipse spectrscopy had developed rapidly and solar eclipses attracted widespread and co-ordinated interest amongst astronomers of the world.

One of the earliest (1869) spectroscopic observations of the light from the corona was the well-known green line $\lambda\,5303$ whose origin remained a mystery as the same could not be produced by any known element on the earth. The line was attributed to a new element 'coronium'. Now we know that it is due to the iron atom in a highly ionized state, *viz.*, Fe XIV ($^2P_{3/2}$–$^2P_{1/2}$) with an ionisation potential of 355 volts.

The development of a working coronograph by the French astronomer Lyot in the early thirties of the present century ushered in a new era in coronal science. In principle, the coronograph uses an occulting disc at the focus of the telescope to cut out the photospheric light, and by means of other optical devices enables the slit of the spectroscopic attachment to be illuminated by coronal light only. The perfection of the coronograph has enabled observational study of the corona to be made at all times. There are now nearly a dozen coronograph stations, many located at high altitudes, throughout the world which are in regular operation taking daily observations, in contrast to the few minutes' observations at total solar eclipses occurring decades apart.

The spectrum of the corona consists of a continuum produced by the scattering of the photospheric light by the coronal electrons, and superposed on this continuum is a bright line spectrum. Near the sun and at time of high sunspot activity the more intense of these lines may be 50–100 times as bright as the coronal continuum, which in turn is only a few millionths of the brightness of the photospheric continuum. The study of these lines—their identification, their variation in brightness with position in the corona and with the solar cycle, and the explanation of their presence and behaviour—constitutes a major part of coronal science.

Out of the entire list of lines, three are particularly useful for following the day-by-day

changes in the corona. These are the red line λ 6374 of Fe X, the green line λ 5303 of Fe XIV, and the yellow line λ 5694 of Ca XV. They are in a very accessible part of the spectrum for visual observation or photography ; they come from widely separated states of ionization—the ionization potential for Fe X is 235 V, for Fe XIV is 355 V, and for Ca XV it is 820 V. Thus the red gives information about the cooler portions of the corona, the green line on the regions of intermediate temperature and the yellow line on the hotter regions.

Various aspects of spectral studies of the corona like the width of coronal line profiles, the identification of the lines as due to highly ionized atoms, the absence of emission lines of hydrogen and helium which are the major constituents of the coronal material, the emission of X-rays and extreme ultraviolet rays by the corona, and above all the results of radio astronomical investigations of the corona, have

confirmed the conception of a hot corona in the million degree range.

While the hot corona has solved many problems that were puzzles before, it has also created new problems that await understanding. These are : (1) the need of an adequate description of the heating mechanism ; (2) our ignorance of the dynamic structure of the corona ; (3) the apparent discrepancy between the chemical composition of the corona and the photosphere ; (4) our surprising lack of understanding of the relation between the inner and the extended portions of the corona.

The book under review gives a comprehensive survey of the solar corona, including both observations and theoretical considerations. It will be a useful guide book to students and researchers as it considers not only established ideas but also reasonable speculation on the subject.

DECAY OF TANTALUM-182*

P. C. MANGAL, S. P. SUD AND P. N. TREHAN

Department of Physics, Panjab University, Chandigarh-14

TANTALUM-182 decays by negation emission with a half life of 115 days to W^{182}. The level scheme of W^{182} has been investigated by a number of workers.[1-4] Most of the levels, shown in Fig. 1, have been well established. A weakly fed level at 680 keV is not confirmed by some workers.[5] A very weak γ-ray of 1410 keV, reported by K. Korkman *et al.*,[5] does not fit into the present level scheme of W^{182}.

In the present study the level scheme of W^{182} has been investigated using a sum-peak coincidence spectrometer in almost 4π geometry.[6] The block diagram of the spectrometer is shown in Fig. 2. Since this spectrometer, when used in 4π geometry, has the highest coincidence detection efficiency and is almost insensitive to minor electronic drifts, it is considered to be a good tool for studying the weak and multiple cascading γ-rays as are encountered in the decay of Tantalum-182. The sum-peak coincidence spectrum, with integral bias settings of about 80 keV, is shown in Fig. 3 a. All the sum-peaks, showing up in this spectrum, except two peaks at 590 and 1810 keV, fit well with the reported γ-rays

in W^{182}. The sum-peak at 590 keV shows up due to the summing of 351 and 229 keV γ-rays

FIG. 1. Level scheme of Tantalum-182

of 351–229–100 keV cascade. This indicates the existence of a level at 680 keV which arises

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FIG. 2. Block diagram of a sum-peak coincidence spectrometer.

posed at 1740 keV which deexcites by 1410–229–100 keV triple cascade. In order to check the existence of this cascade a sum-peak coincidence spectrum, with integral bias settings raised to about 390 keV, has been run and is shown in Fig. 3 b. In this setting 100, 229 keV γ–rays and the single crystal sum of 100 and 229 keV γ–rays are biased out. There is no indication of 1810 keV sum-peak in this spectrum. In the region of 1810 KeV a flat background comes up which is mainly because of the chance summing of high energy γ-rays of W^{182}. The spectrum of curve (b) was subtracted from that of curve (a) in order to take care of the chance contribution from the former spectrum. The high energy portion of the subtracted spectrum is shown in the inset of this diagram. Here 1810 keV peak is showing up more clearly which clearly indicates a new level at 1740 keV.
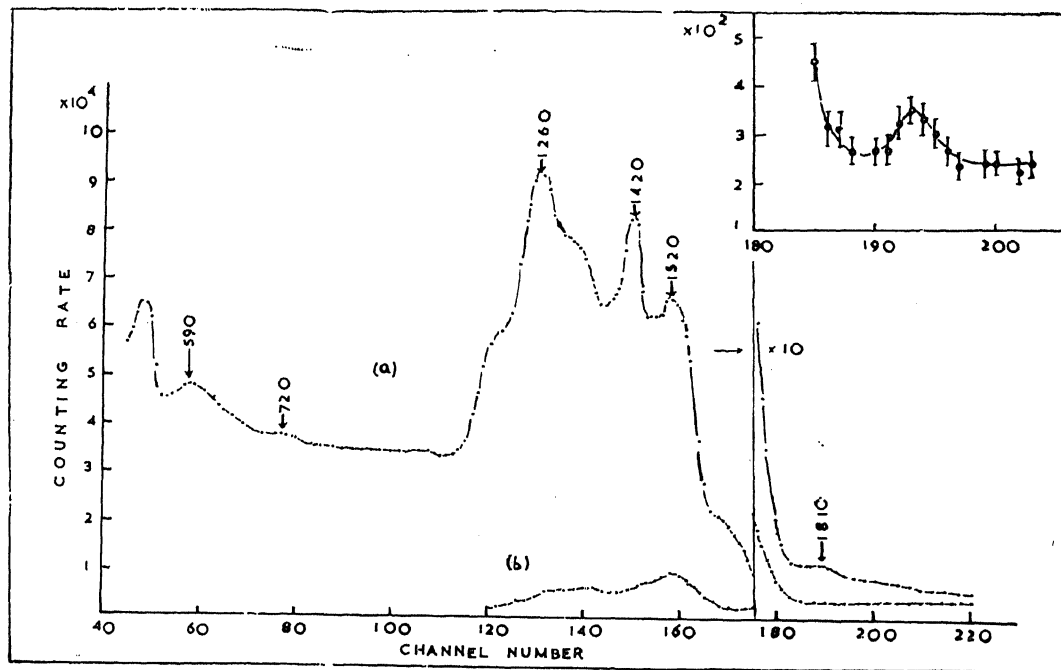
FIG. 3. Sum-peak coincidence spectra of tantalum-182. Curve (a): Integral bias settings at 80 keV. Curve (b): Integral bias settings at 390 keV.

because of the triple summing of 351, 229 and 100 keV γ-rays. The sum-peak energy in both the cases is higher from the actual sum by the expected amount.[7] A sum-peak at 1810 keV is explainable if we assume the summing of 1410, 229 and 100 keV γ-rays. Since a triple sum-peak in this energy range is expected to be about 70 keV higher than the actual sum of the constituent γ-rays,[7] a new level is pro-

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DETERMINATION OF THIOBENZOIC ACID WITH CHLORAMINE-T AND DICHLORAMINE-T

T. JOSE JACOB AND C. G. RAMACHANDRAN NAIR*

Department of Chemistry, University of Kerala, Trivandrum-1 (India)

THIOBENZOIC acid is widely used as a catalyst for the synthesis of polymers of vinyl imidazolines and vinyl tetrahydropyrimidines. In view of the ability of chloramine-T to rupture C–S, N–S, S–S and P–S bonds in a variety of sulphur compounds[1-12] oxidising the entire sulphur to sulphuric acid, and dichloramine–T being an oxidimetric reagent in non-aqueous[13] and partially non–aqueous[14] media, it was of interest to study the reactions of thiobenzoic acid with chloramine-T (CT) and dichloramine-T (DCT). The results of such studies are presented in this communication.

Reagents.—Fluka AG "Guaranteed Reagent Fro Analysi" Thiobenzoic acid was employed for the present work. Standard solutions of thiobenzoic acid were prepared in glacial acetic acid. Stock solutions of chloramine-T and dichloramine–T were prepared, standardized and preserved, in conformity with the recommendations of Bishop and Jennings[15] and the present authors[13-14] respectively.

Procedure.—(*a*) With chloramine-T in alkaline medium : Measured aliquots of the chloramine-T solutions were taken in 500 ml. glass-stoppered conical flasks and 30 ml. of 5N sodium hydroxide were added to each. Known volumes of the standard thiobenzoic acid solutions were now introduced with shaking. The mixtures were heated to 60° C. and kept at that temperature for about half an hour, when the solutions became clear. The solutions were cooled to room temperature and excess of 5N sulphuric acid and 15 ml. 10% aqueous potassium iodide were added. The liberated iodine was estimated by titrating it with standard thiosulphate solution. From the amount of chloramine-T consumed, the ratio of equivalents of oxidant consumed per mole of thiobenzoic acid was calculated. Typical results are given in Table I.

(*b*) With dichloramine-T in non-aqueous medium : Measured aliquots of the dichloramine-T were taken in a glass-stoppered conical flask and added 30 ml. of glacial acetic acid, 5–10 ml. water and a sample aliquot of the thiobenzoic

* Present address : Alexander von Humbolt Fellow, Anorganisch-Chemisches Institut der Universitäte, Hedelberg, West Germany.

TABLE I
Oxidation of Thiobenzoic Acid by Chloramin-T

Exp. No.	Millimoles of thiobenzoic acid taken	Milliequivalents of chloramine-T consumed	No. of equivalents of oxidant consumed per mole of thiobenzoic acid
1	0·2016	1·615	8·009
2	0·2521	2·018	8·004
3	0·2521	2·027	8·041
4	0·3529	2·822	7·997
5	0·4033	3·223	7·993

acid solution. With the stopper in place allowed the flask to remain 30 to 40 minutes at room temperature (28° C). Diluted to 200 ml. with water, added 10% aqueous potassium iodide solution and titrated the liberated iodine with standard thiosulphate solution to the starch end point. From the amount of dichloramine-T consumed, the ratio of equivalents of oxidant consumed per mole of thiobenzoic acid was calculated. Typical results are given in Table II.

TABLE II
Oxidation of Thiobenzoic Acid by Dichloramine-T

Exp. No.	Millimoles of thiobenzoic acid taken	Milliequivalents of dichloramine-T consumed	No. of equivalents of oxidant consumed per mole of thiobenzoic acid
1	0·2614	2·086	7·982
2	0·2614	2·076	7·943
3	0·3025	2·439	8·063
4	0·3529	2·821	7·995
5	0·4033	3·228	8·005

Blanks were run concurrently for both ; no blank corrections were necessary.

Results and Remarks.—It may be seen from the Tables I and II that eight equivalents of oxidant are consumed per mole of thiobenzoic acid.

This is in agreement with the following oxidation schemes.

$$\underset{\displaystyle \overset{O}{||}}{C_6H_5.C.SH} + 10\ OH^- \leftarrow C_6H_5.COOH + SO_4^{-2} + 5H_2O + 8e$$

(in alkaline medium with CT)

$$\underset{\displaystyle \overset{O}{||}}{C_6H_5.C.SH} + 5H_2O \rightarrow C_6H_5.COOH + SO_4^{-2} + 10\ H^+ + 8e$$
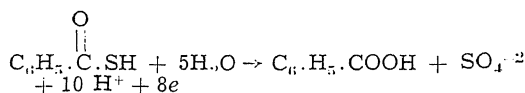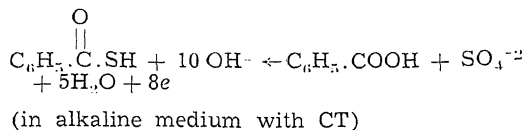
(in acid medium with DCT).

The large number of equivalents consumed per mole of the substance indicates that the chloramine-T and dichloramine–T oxidation methods should be very accurate analytical procedures for the estimation of thiobenzoic acid in aqueous and non-aqueous media, respectively, in which traces of water accelerate the oxidation.

Independent experiments carried out by the present authors have shown that benzoic acid is not further oxidised by chloramine-T under the experimental conditions.

The oxidation of thiobenzoic acid by chlor-amine-T was studied under various conditions. The oxidation was found to be incomplete in acid medium at room temperature (28° C.). The data obtained at elevated temperatures were inaccurate. Oxidation in alkaline medium was found to be incomplete at room temperature ; a turbidity due to partial separation of elemental sulphur was visible in this case. The turbidity disappeared on warming to 60° C. Finely divided sulphur is known to react quantitatively with alkali forming a mixture of sulphide, sulphite and thiosulphate,[16] all of these sulphur oxianions are further oxidised by chloramine-T to the sulphate ion.[8]

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COLCHICINE-INDUCED DWARF-*CUM*-STERILE MUTANTS
IN *SORGHUM VULGARE* L.

E. A. SIDDIQ

Division of Genetics, Indian Agricultural Research Institute, New Delhi-12

TILL 1952, the effect of colchicine was restricted to induction of polyploidy alone and with the pioneer works of Franzke and Ross (1952, 1956, 1957, 1960)[5-8] in Experimental-3, a homozygous sorghum line, the possibility of chromosomal reduction followed by doubling along with a change in the genetic constitution was understood. Through colchicine treatment they could produce a large number of homozygous variants in Experimental-3 all of them showing normal meiosis with ten bivalents. Specifically Chen and Ross (1963)[1] came across a male sterile mutant but with normal meiotic chromosome behaviour. Later Erichsen and Ross (1963),[4] and Erichsen (1963)[3] reported similar male sterile plants following colchicine treatment. Chopde (1965)[2] reported dwarf-*cum*-sterile mutants following colchicine treatment in *Cajanus cajan* Millsp.

During the course of induction of polyploidy through colchicine in sorghum hybrids, two dwarf plants with total sterility were come across in MS × IS 1054.

The seedlings were treated with 0·2% aqueous solution of colchicine for seven to eight hours by inverting the seedlings of 1 cm. long plumule which were decapitated just above the meristematic region before treatment. Two of such treated seedlings gave rise to weak, dwarf and sterile plants. The average height of these dwarfs was less than half the height of the control (Table I). From the measure-

showing a complete sterility. When the plants were pollinated with the pollen from the control plants, they did not set any seed, showing an induced sterility on the female part of the flower also. However the cytological analysis of the PMCs showed a perfect meiosis in all the randomly fixed spikelets except for occasional nucleolar budding to the extent of two to six.

FIG. 1. Control and colchicine induced dwarf-*cum*-*sterile*s.

TABLE I

A comparative study on the morphology of the Dwarf mutants and control

(Measurements in cm.)

Material	Height	Internodal length (from top)			Leaf size		Ear length	Spikelet length	% of fertility
		2–3	3–4	4–5	Length	Breadth			
Control	173	15·5	15·3	15·3	59	6·3	24·4	0·55	95–98 %
Dwarf mutants	68–71	3·5	3·0	2·8	24	2·5	11·0	0·50	Total sterility

ments of internodal length and number of leaves it was apparent that the reduced internodal length led to the dwarfness. The size of leaf, panicle and spikelet was also found to be proportionately reduced. The pollen was

The male sterility observed by Ross and his co-workers has been attributed to genic mutation probably occurred during the process of somatic reduction followed by doubling. Though the present study lacks experimental proof for the

existence of the phenomenon of somatic reduction and doubling, there is a strong evidence to show that colchicine acts as a mutagenic agent the details of which will be published separately.

Height character in *Sorghum* is said to be governed by a set of four genes, namely Dw_1, Dw_2, Dw_3 and Dw_4 (Quinby and Karper, 1954).[11] The female parent which is male sterile (Kafir-60) used in the present study is a two dwarf having the genetic consitution of Dw_1 Dw_1 Dw_2 Dw_2 dw_3 dw_3 dw_4 dw_4 whereas the male parent being homozygous dominant for all the four genes, *i.e.*, Dw_1 Dw_1 Dw_2 Dw_2 Dw_3 Dw_3 Dw_4 Dw_4. The plants were of uniform height (Table I) in control, whereas two of the colchicine-treated plants were found to be dwarfs. They were very short with profuse tillering and narrow leaves (Table I). Apart from changes in the vegetative parts both male and female organs of the spike were found to be totally sterile. Occurrence of the dwarfs in the C-1 generation can be explained by the phenomenon of induced mutation caused by colchicine. Possibly two of the height genes which were in their heterozygous condition must have been mutated to their respective recessive condition. If the mutation in the two heterozygous genes is the explanation for their occurrence, the colchicine-induced dwarfs should resemble two-dwarf normal male sterile Kafir-60. However, still reduced height, profuse tillering, narrow and short leaves and female sterility made them differ from normal male sterile parent. In this case it is to be assumed that one or more height genes might have been mutated to recessive or heterozygous condition. Karper (1932)[9] is of the view that any of these four genes may be unstable leading to the spontaneous mutation towards any direction. Further, the decreased height in these mutants was obviously due to the shortened internodes. According to Quinby and Karper (1945, 1954)[10,11] these four independently inherited height genes of a modifying complex influence the elongation of the internodes alone whereas time of blooming, leaf size, etc., remain unaffected. Contrarily the mutants under study were characterised by having comparatively short and narrow leaves with a whorled type of leaf arrangement.

From the sterility point of view, the female parent Kafir-60 is having the genotype of cc, while the male parent IS-1054 has a homozygous dominant gene CC. The fertility character being governed by a dominant gene, the F_1 shows full fertility. The mutants under study showed complete sterility in F_1 itself strengthening the possible occurrence of mutation towards homozygous recessive condition, *i.e.*, from Cc to cc. In such a case the plant should be necessarily male sterile. But the interesting feature was the associated female sterility. Here once again we have to assume the occurrence of induced mutation in the locus governing female fertility.

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LETTERS TO THE .EDITOR

CRYSTALLOGRAPHIC DATA ON SODIUM TRIHYDROGEN SELENITE

SODIUM trihydrogen selenite, $NaH_3(SeO_3)_2$, is ferroelectric with the Curie point at $-79°$ C.[1] Infra-red and magnetic resonance studies on this compound have been reported,[2-4] but no structural data are so far available. Hence it was thought worthwhile to analyse its structure as part of a programme, undertaken in this department, of systematic X-ray investigation of some ferroelectric crystals.

Transparent platy crystals, elongated along the b-axis, of sodium trihydrogen selenite were grown by slow evaporation at room temperature of a saturated aqueous solution of selenium dioxide and sodium carbonate in stoichiometric molar ratio. The unit cell dimensions were determined from oscillation and Weissenberg photographs taken about crystallographic axes using nickel-filtered copper radiation. The following reflections were found to be systematically absent :

$$h\,0\,l,\ h+l = 2n+1;$$
$$0\,k\,0,\ k = 2n+1.$$

Hence, the crystals were uniquely assigned to the monoclinic space group $P2_1/n$. The density of the sample was measured by flotation in a mixture of methylene iodide and bromoform. The crystal and physical data of the compound are as follows :

Space group—$P2_1/n$
$a = 10\cdot35 \pm 0\cdot02$ Å, $b = 4\cdot84 \pm 0\cdot02$ Å
$\qquad c = 5\cdot84 \pm 0\cdot02$ Å, $\beta = 89 \pm 1°$

Volume of the unit cell $\quad = 292\cdot37$ Å³
Formula weight $\qquad\qquad = 279\cdot93$
Number of formula weights
  in the unit cell $\qquad\qquad = 2$
Measured density $\qquad = 3\cdot20 \pm 0\cdot01$ gm./c.c.
Calculated density $\qquad = 3\cdot18$ gm./c.c.
Absorption coefficient for
  X-rays $(\lambda = 1\cdot5418$ Å$) \quad = 185\cdot5$ cm⁻¹.

The multiplicity of general position in the space group is fourfold, and as there are only two $NaH_3(SeO_3)_2$ units in the cell, the sodium ion and one of the hydrogens should occupy twofold special sites whereas the $HSeO_3$ units are at general positions. The complete determination of the structure is under progress.

The author is grateful to Prof. R. S. Krishnan for his kind and continued interest

and Mr. S. Devanarayanan for supplying the material used in this investigation. His thanks are also due to the Council of Scientific and Industrial Research for the award of a Senior Research Fellowship.

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NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF *o*-DIFLUOROBENZENE IN VAPOUR PHASE

THE absorption spectrum of *ortho*-difluorobenzene molecule in vapour phase has been photographed with the Hilger medium and large quartz spectrographs. Path lengths ranging from 10 to 150 cm. were used. The temperature was varied from 28° C. to 80° C. Hilger hydrogen arc lamp was used as the source of continuous radiation. Ilford N 30 plates were used to record the spectrum. Measurements were made with the help of Hilger Comparator having least count of $0\cdot001$ mm., taking iron as standard. The wave numbers are accurate upto ± 2 cm.⁻¹ for sharp bands and upto ± 5 cm.⁻¹ for diffuse and broad bands.

This molecule belongs to C_{2v}* group symmetry. The region of absorption shows that the electronic transition in question corresponds to the normally forbidden $A_{1g} \to B_{2u}$ transition of benzene. In the case of the above symmetry the corresponding electronic transition becomes $A_1 \to A_1$, which is allowed, with the transition moment lying along the X-direction bisecting *ortho* C–C bond. The strong band at 2642.7 Å (37829 cm.⁻¹) has, therefore, been assigned as the 0, 0 band of the system.

Frequency separations 170, 306, 430, 561, 767 and 1032 cm.⁻¹ (from the 0, 0 band) of bands lying to the longer wavelength side of the 0, 0 band have been taken to be the fundamental vibrational frequencies in the ground state (G.S.). Similarly frequencies 237, 398, 550, 720, 924, 1087, 1265 and 1387 cm.⁻¹ occurring in

TABLE I

Correlation of Raman, infra-red and ultraviolet ground, excited state frequencies

Raman shifts (liquid)	Depolarisation data	Infra-red frequencies (Vapour)	Band type	Ultraviolet absorption frequencies		Mode of vibration
				G.S.	E.S.	
197 (s)	0·9	··	··	170 (s)?	··	··
296 (m)	0·89	··	··	306 (ms)	237 (s)	Out-of-plane ring bending
436 (w)	0·9	··	··	430 (s)	398 (s)	C–F bending i.p.
566 (m)	0·4	567 (m)	A	561 (ms)	550 (vs)	C–C–C bending i.p. (totally symmetric component a₁ofe_g¹ 606 in benzene)
762 (vs)	0·2	762 (m)	A	767 (ms)	720 (vs)	C–C ring breathing
1020 (s)	0·1	1024 (m)	A	1032 (vw)	924 (s)	C–C–C trigonal bending
1152 (m)	0·6	1155 (vw)	A	··	1087 (s)	C–H bending i.p.
1269 (s)	0·2	1279 (s)	A	··	1265 (s)	C–F stretching
1469 (vw)	··	1464 (m)	··	··	1387 (s)	C–C stretching

Letters in parentheses indicate observed intensities. vs = very strong, s = strong, ms = medium strong, m = medium, mw = medium weak, vw = very weak and i.p. = in plane.

prominent bands on the shorter wavelength side of the 0, 0 band have been assigned as the excited state (E.S.) fundamentals.

The ground and excited state frequencies together with corresponding Raman and infra-red[1] frequencies are tabulated in Table I. The agreement can be seen to be quite satisfactory. Some of the prominent frequencies have also been assigned to definite modes.

There are bands at separations of 12, 34, 40, 63 and 96 cm.⁻¹ on the red side of the 0, 0 band. These may be due to v–v transitions of the low-lying vibrations in the two states.

Thanks are due to Professor D. Sharma for help and guidance. One of us (ANP) is grateful to the authorities of Bhagalpur University for granting study leave.

Department of Physics,   L. N. TRIPATHI.
University of Gorakhpur,   A. N. PATHAK.
Gorakhpur, U.P., India,
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FRANCK-CONDON FACTORS AND r-CENTROIDS OF THE C′-X SYSTEM OF PO MOLECULE

VIBRATIONAL analysis of the bands of the C′-X system of PO lying between 2248 Å and 2958 Å made by Santaram and Rao[1] (1962) revealed the absence of (1, 2), (2, 0), (2, 1), (3, 0) and (4, 0) bands. The Franck-Condon factors are mainly responsible for the intensity distribution in the vibrational structure of a band system, and it was thought worthwhile to compute these and compare the results with the observations. Recently Sankaranarayan[2] (1966)

has calculated the r-centroid values and Franck-Condon factors for the bands of the A-X system of PO molecule.

Since for this system $|d\alpha/\alpha| = 0.46\%$, the method of α-averaging outlined by Fraser and Jarmain[3] (1953) has been employed to evaluate the Franck-Condon factors. Data for the calculation were obtained from Singh[4] (1959) and Narasimham *et al.*[5] (1965). The results are given in Table I in parentheses. The r-centroids, $r_{v',v''}$ were calculated by the graphical method developed by Nicholls and Jarmain[6] (1956) and are also shown in Table I along with the wavelengths of R_1 heads taken from the analysis of Santaram and Rao.[1]

TABLE I

Franck-Condon factors and r-centroids of the bands of C′-X system of PO

v'' / v'	0	1	2	3	4
0	(0·153) 1·529 2290·66	(0·286) 1·560 2356·05	(0·273) 1·593 2425·04	(0·172) 1·626 2497·34	(0·082) 1·658 2573·11
1	(0·267) 1·503 2248·28	(0·120) 1·539 2311·74	(0·000) ·· ··	(0·294) 1·603 2447·66	·· ·· ··
2	(0·098)	(0·001)	(0·089) 1·550 2333·84	(0·147) 1·582 2400·83	··
3	(0·071)	(0·065)	(0·055)		
4	(0·054)				

Fist row: (in parenthesis) : Franck-Condon factors.
Second row : r-centroids in A.U.
Third row: Wavelengths of the bands in A.U.

A smooth curve is obtained by plotting $\bar{r}_{v',v''}$ against $\lambda_{v',v''}$ and it was found that $\bar{r}_{v',v''}$ increases with λ. The calculated Franck-

Condon factors explain the absence of (1,2), (2,0), (2,1), (3,0) and (4,0) bands.

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NMR STUDIES WITH BASSIC ACID AND ACETYLBASSIC ACID

DURING the course of our investigations on the detoxification of mowra meal, left after removal of oil from *Bassia latifolia* seeds, for feed purposes, bassic acid was isolated by the method of Heywood *et al.*[1] These workers characterised bassic acid as trihydroxy-triterpene acid, $C_{30}H_{46}O_5$. King and Yardley[2,3] recently re-investigated the chemistry of bassic acid in detail. From the ready oxidation of methyl bassate to an oxo-derivative as well as the quantitative oxidation of methyl deoxybassate by periodate, these workers deduced that hydroxyl positions at 2 and 3 must be *cis*. Further confirmation of the *cis* nature of the oxygen functions was sought by these workers by the stereospecific reduction of the 2,3-diketone by borohydride which produces predominantly β-alcohols. On this basis, King and Yardley concluded that both the hydroxyl groups are probably β-oriented.

The present NMR studies with bassic acid and its acetyl derivative give a more direct proof for the β-orientation of the hydroxyl groups at positions 2 and 3. NMR spectra, recorded at 60 mc./sec. using tetramethylsilane as standard, showed that the peak due to α-proton at C-2 moved to a lower frequency, 5·01 ppm in acetyl derivative. This shift was 1·10 ppm which is in the accepted range of shift for the shielded α-protons.[4,5] Moreover, the peak due to vinyl protons of $\triangle^5$-unconjugation appeared at 5·58 ppm in both bassic acid and its acetyl derivative. From the studies

with steroids having $\triangle^5$ unconjugation it has been observed that the position of vinyl protons is not shifted by acetylation of 3 β-hydroxy group and that acetylation of 3 α-hydroxyl causes these protons to shift upfield by 0·20 ppm.[4,6] Since the vinyl protons have not been shifted in acetylbassic acid and the α protons were indeed shifted to a lower frequency in the acetyl derivative, the hydroxy groups at 2 and 3, must be β-oriented in bassic acid (see Fig. 1).
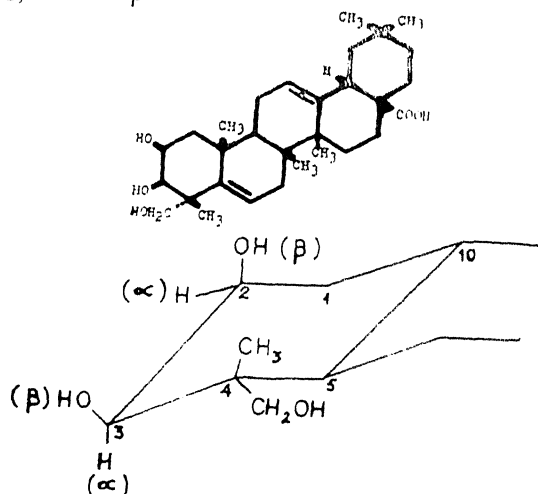
In this context, mention could be made of Djerassi's observation that no 2 α, 3 α-glycol of the steroidal or triterpenoid series occurs in nature.

Dept. of Chemical Tech.,   N. VENKATESAN.
University of Bombay,   H. P. TIPNIS.
Matunga, Bombay-19,   D. V. REGE.
February 14, 1967.

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BENZIL-α-MONOXIME COMPLEXES OF RARE EARTHS

RARE EARTH complexes have received considerable attention because of their possibe application to Lasers.[1] Much work has been done on the complexes on systems containing oxygen donors.[2] Recently complexes with systems containing nitrogen donors[3] have been prepared and found to fluoresce in the visible region of the spectrum. In order to investigate the fluorescence properties of rare earth complexes with systems containing nitrogen and oxygen donors, several aldoximes and ketoximes have been chosen. Recently[4] pyridine-2–aldoxime complexes of rare earths were reported.

Benzil-α-monoxime   (M.P.   137° C.)   was obtained from the National Chemical Laboratory, Poona, India. It was used without further purification.

A weighed amount of the rare earth oxide (99·9%) was dissolved in A.R. grade hydrochloric acid and the resulting chloride solution was carefully evaporated to dryness on a steam bath to remove the acid. The residue was dissolved in 15 ml. of absolute ethanol and a calculated amount of the ligand (mole ratio 1 : 3) in 25 ml. of ethanol was added and the pH of the solution was adjusted to the optimum value by the addition of alcoholic ammonia. The solution was slowly concentrated on a steam-bath, when the solid complex separated. The solution was fitered, washed with benzene to remove excess ligand, purified from ethanol and vacuum-dried. It was shown (a weighed amount of the dried chelate was ignited in a platinum crucible and the residual oxide weighed) that the metal to ligand ratio is 1 : 2.

Spectral Data.—The absorption spectra in the visible region and ultra-violet region were recorded using a Hilger-Watts spectrophotometer. Infra-red spectra were recorded on a Perkin-Elmer model 137 infracord. The compounds were examined as nujol mulls.

In the ultra-violet region the ligand has only one absorption maxima at 250 mμ in ethanol ($\epsilon = 19,430$). Table I details the λ_{max}. and ϵ_{max}.

TABLE I

Compound	Ethanol	
	λ_{max}. m μ	ϵ_{max}.
Benzil α-monoxime ($C_{14}H_{11}NO_2$)	250	19,430
Sm ($C_{14}H_{11}NO_2$)$_2$Cl$_3$	245	23,630
Eu ($C_{14}H_{11}NO_2$)$_2$Cl$_3$	250	47,790
Dy ($C_{14}H_{11}NO_2$)$_2$Cl$_3$	250	26,970

values of the ligand and the chelates in the solvent ethanol. There is moderate intensification in ϵ_{max}. values of all the chelates.

Sm^{3+}, Eu^{3+}, Dy^{3+} have characteristic absorption maxima at 402 mμ, 395 mμ, 910 mμ respectively. In the chelates investigated the characteristic absorption maxima could not be located.

The infra-red absorption bands of benzil-α-monoxime was recorded.[5] The free OH stretching of the N–OH group in oximes normally has an absorption between 3600 cm.$^{-1}$–3500 cm.$^{-1}$ The oxime now investigated has shown an absorption at 3650 cm.$^{-1}$ and is due to the free OH stretch of the oxime. In all the chelates investigated the band is shifted and is located between 3500–3300 cm.$^{-1}$ The C=N stretch in oximes is normally located around 1670 cm.$^{-1}$ The band located at 1655 cm.$^{-1}$ in the ligand and at 1647 cm.$^{-1}$ in all the chelates is due to the C=N stretch. The N–O stretch[6] vibration normally exhibits two absorption maxima, one at 1240 cm.$^{-1}$ and the other at 1080 cm.$^{-1}$ In the free ligand the two bands are located at 1205 cm.$^{-1}$ and 1070 cm.$^{-1}$ Both the bands are located in all the chelates investigated without much variation.

Dept. of Chemistry,   V. RAMACHANDRA RAO.
Marathwada University,
   Aurangabad, India and
Dept. of Chemistry,   P. RADHAKRISHNA MURTY.
Osmania University,
Hyderabad, India, *December* 14, 1966.

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CHEMICAL STUDIES OF *JASMINUM AURICULATUM* (VAHL) LEAVES

Jasminum auriculatum (Vern-Juhi) is a shrub with fragrant flowers which are given in consumption[1] and juice of the expressed leaves for local wound healing.[2] This last aspect has prompted us to undertake a chemical examination of leaves.

Air-dried powdered leaves (2·5 kg.) were

extracted with hot ethanol. The alcohol-free defatted extract gave a red viscous oil, which, when dissolved in hot benzene and treated with methanol, separated into a semi-solid mass. It was run over neutral alumina and eluted with benzene, ethylacetate mixture. The product thus obtained was rechromatographed over the same adsorbent with benzene, petroleum ether (40-60°) and chloroform mixture as eluent. This gave a white crystalline solid, which, on recrystallisation with ethanol, gave two products: (i) m.p. 170-195° and (ii) 200-205°. The second fraction was crystallised first with methanol, m.p. 212° and then with methanol, ethylacetate, m.p. 212°, $[a]_D = + 24°$ (chloroform). This gave a single spot over thin layer chromatogram silica-gel G; benzene, heptanes (97-98°), ethanol (50 : 50 : 0·5) $(R_f = 0·214)$.[3] It was identified as lupeol by comparison with an authentic sample, mixed m.p. 212°.

Fraction m.p. 170-195° crystallised from ethylacetate, methanol as long needles, m.p. 208°. It gave a single spot over silica gel G. Chromato strip, $R_f = 0·22$ [benzene, heptanes (97-98°), ethanol (50 : 50 : 0·5] and there was considerable lowering in mixed melting point with lupeol. It responded to Liebermann-Burchard Reaction and gave positive Noller's Reaction (yellow → orange → red → purple). It may therefore be a triterpene. Further work is in progress.

By paper chromatographic studies presence of potassium[4] and iron in ash of dried leaves, mannitol[5] and considerable amount of starch in cold aqueous percolate, indole[6] in soxhleted ether and ethanolic extracts was established.

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Chemistry Department,   S. M. Deshpande.
Banaras Hindu University,   R. R. Upadhyay.
Varanasi-5, *December* 14, 1966.

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THE EFFECT OF ARECOLINE AND SOME CNS DRUGS ON 'MOTOR LEARNING' IN RATS

The advent of 'psychotropic drugs' has revealed the specificity of drug action on the neurons of the central nervous system[1] and thus opened up the field for investigations on many higher functions of the CNS which were hitherto considered to be beyond the domain of drug therapy. Examples of such functions are 'Learning' and 'Memory'.

The modification of performance by experience is learning—previous conscious awareness of the experience which results in an enduring change in the neural apparatus can be defined as Memory.

Though not actually located in any particular region of the brain, the subcortical areas of the temporal region are known to be intimately associated with memory mechanism.[2] The reception, retention and retrieval of the information, which constitute the various phases of memory are integral part of the activity of the neurons. Since the electrical activity of the CNS cells, though not so well demarked as in peripheral neurons, result from the action of the chemical mediators like acetylcholine, adrenalin, noradrenalin, 5HT, GABA and others[3] and the manifestation of the electrical activity is the basis of nerve function which includes learning and memory, all chemicals exhibiting potent sympathomimetic or parasympatho mimetic action or inhibition may influence these functions.

In this study, the influence of arecoline—the alkaloid of *Areca catechu* nuts which exhibits powerful muscarinic effect and is known to specifically influence the reticular formation in the brain[4,5] has been tested for its effect on a simple motor learning' task in rats and compared with other drugs which affect the central nervous system.

Various methods are available for learning procedures'. One such is the 'Maze learning'. Learning is indicated when, on repeated trials, the shortest path is taken in the shortest time.

Male rats 40-65 g. in weight were trained to run in a T maze for food reward as described in our earlier studies.[6] When the animals had reached a high level of proficiency they were injected intraperitoneally with the drugs to be tested, after a first trial run. They were then rerun at 5 minutes and half an hour intervals. The drugs tested and the effects observed are shown in Table I. The results are the averages of six replications,

TABLE I

*The influence of arecoline and other CNS drugs
on motor learning in rats*

	Dose mg./kg.	Running time	Errors	Food intake
Arecoline hydrochloride ..	1	Inc	0	Dep
Acetylcholine chloride ..	1	Inc	0	N
Nicotinic hydrogen tartrate ..	1	—	Inc	Dep
	0·5	N		N
Atropine sulphate ..	0·3		Inc	Dep
Hyocyamine ..	1	—	—	Dep
Benactyzine hydrochloride ..	1	N		N

N = Normal.   Inc = Increased.   Dep = Depressed.
0 = Nil.

To study the influence of the drugs on the co-ordinated and stable movements, the rats were placed on the rotating rod (7 revolutions per minute) and their ability to maintain the equilibrium was observed. This was done immediately after the maze trials were run at 5 min. and half an hour intervals.

The results are shown in Table I.

After acetylcholine, 1 mg./kg. I.P. increase in the running time but no effect on food consumption was seen.

Arecoline 1 mg./kg. I.P.—At the end of 5 min. trial, some rats were found to be slightly sedated and did not move from the platform. At the end of half an hour, rats had regained activity, but took longer time to reach the goal and even then food was not consumed by 50% of the animals. The rota rod test showed that with arecoline at the dose given, there was no in-co-ordination either at 5 mins. or half an hour interval. The loss of appetite and the increased time for reaching the goal appear to be due to a depressant effect of arecoline on CNS.

Nicotine Hydrogen Tartrate: 1 mg./kg. I.P.— The rats were active but showed loss of stability on the rota rod. As with arecoline the rats, though reaching the goal did not consume the food. At 0·5 mg./kg. I.P., the ataxia was absent and no interference on the conditioning was seen.

The influence of cholinolytics was next studied. Atropine suphate 0·3 mg./kg., S.c, suppressed the food intake and increased the number of errors even at the end of 1 hour. The rats were not ataxic and moved to the goal.

Hyocyamine: 1 mg./kg. I.P.—The number of errors in reaching the goal increased and the food intake suppressed. In a few rats there was delay in reaching the goal and taking the food pellet.

Benactyzine: 1 mg./kg. I.P.—Slight increase in running time seen at the end of 5 min. This had reached normalcy by half an hour. Food intake was normal.

In general it may be stated that acetylcholine does not influence the motor learning and food intake but slightly increased the running time.

Arecoline besides increasing the running time affects the food intake.

Nicotine in non-ataxic doses has no adverse effect on the motor learning.

Amongst the cholinolytics, atropine affects the motor learning as seen by increasing errors. Food intake was also suppressed. Benactyzine effect was very mild causing a slight increase in number of errors at 5 min. with no other adverse influence. The Hyocyamine effect was similar to that of atropine.

These drug effects appear to simulate those obtained on condition avoidance response (CAR). In this CAR study also Ach. has been shown to have no effect while arecoline inhibits the CAR.[7]

These studies indicate that cholinolytics adversely influence the learning. The acute effect of arecoline in the dose given is one of sedation and depression of CNS.

The effects of varying doses and repeated administration of these drugs on 'Learning' is under study.

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Pharmacology Laboratory,   M. Sirsi.
Indian Institute of Science,
Bangalore-12, *December 20, 1966.*

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EXCRETION OF AMINO-ACIDS BY PLANT ROOTS

AMINO-ACIDS are among some of the substances that are found in the rhizosphere and Lochhead and Thexton[1] suggested that the preferential stimulation of bacteria in the rhizosphere could be ascribed to the excretion of amino-acids by the growing plants. Katznelson et al.[2] found that when roots in soil were dried and re-moistened, large amounts of amino-acids were liberated. Rovira[3] showed that sterile culture medium in which pea seedlings were grown contained amino-acids. Boulter et al.[4] found considerable amount of various amino-acids and peptide materials in the medium in which seed-lings of peas had been grown aseptically with and without quartz sand. The present paper is a preliminary report on a similar study using sterile corn seeds. This work was done at the Agricultural Experiment Station of Rutgers University, New Brunswick, N.J., U.S.A.

The general experimental procedure of this experiment was similar to that of Rovira.[3]

Field corn seeds (J 48 × 1383) were surface-sterilized by momentary immersion in 95% alcohol followed by a 15-minute immersion in mercuric chloride and then washed six times with sterilized distilled water. Twenty of these seeds were germinated on a 4·5% sterilized malt-agar mixture kept in sterilized petri-dishes. After germination, three of the non-contaminated seeds were planted in each of the 10 sterilized petri-dishes containing sterilized circle of filter-paper. After planting the corn seeds, 20 ml. of a sterilized complete nutrient solution of Robbins[5] was added in each of the petri-dishes and then covered with another circle of filter-paper. Petri-dishes, and filter-paper, etc., were sterilized with absolute alcohol and malt-agar mixture and nutrient solution were sterilized by refluxing. Five of the petri-dishes containing corn seeds were kept in dark at room temperature and five of them were kept in a light cycle of 12 hr. light (intensity—about 350 foot-candles) and 12 hr. dark at room temperature. The corn seedlings in both of these sets were grown for 7 days and then they were removed and carefully separated from the filter-paper and discarded, saving the nutrient solution and filter-paper for further analysis. The filter-paper was washed with 0·04 N HCl which is a general solvent for amino-acids. The extract along with the remaining nutrient solution was placed in a vacuum oven at 25° C. and 20 lb. pressure to facilitate concentration. The concentrated solution was then desalted by shak-ing the extract with phenol, ether, and water. This method left residues of phenolic compounds that were not very volatile and persisted for a relatively long period of time. Hence, the second treatment consisted of suspending 5 ml. of the treated extract in 10 ml. acetone contain-ing 10% 10 N HCl, and then letting it stand for one hour before decanting the supernatant which contained amino-acids. The extraction was repeated twice and the extracts were pooled together, dried under vacuum and redissolved in 0·1 N HCl for spotting of the chromatogram. The presence of amino-acids in this solution was then determined by means of two-dimen-sional paper chromatography and two-dimen-sional thin layer chromatography.

Two-dimensional paper chromatograms of all plant root excretions were compared with similar chromatograms that contained a mixture of ten amino-acids, namely, leucine, valine, phenylalanine, alanine, threonine, aspartic acid, glutamic acid, serine, lysine, and glysine, of known concentration (7·5 m. moles). Phenyl-alanine, valine, and alanine were present in all plant root excretions. Leucine and threonine, however, appeared to be present in root excre-tions of plants grown in light and were on only one-third of the chromatograms from root excretions of plants grown in dark. In another study two-dimensional TLC was used and there was observed the "tailing off" of ninhydrin reacting substances, probably due to salt and HCl contamination of these samples. However, glycine-polychromatic ninhydrin complex which forms an orange brown spot with a bright orange ring was noticeably present in all chromatograms.

Rovira[3] and Boulter et al.[4] found serine, asparagine, glutamine, and threonine to be the most prominent amino-acids of exudates of pea roots. Rovira[3] found no evidence for proline, histidine, tyrosine, arginine, isoleucine glycine, and ornithine, but Boulter et al.[4] found all these amino-acids to be present in exudates of pea roots in their experiments. In the present experi-ment, however, I could not separate all the amino-acids clearly on the chromatograms but valine, alanine, and phenylalanine were found to be most prominent amino-acids excreted by corn roots. Threonine, leucine and glycine were also present but were less prominent. The difference in results of these experiments indicates that although both dicot and monocot plants excrete amino-acids, the type and amount of amino-acids excreted by these two types of plants may be different. It is also clear from

this experiment that amino-acids are excreted by plants in their early growth period whether they are grown in dark or in alternating darkness and light.

Ranchi Agricultural   RAMADHAR SINGH.
    College,
Kanke, Ranchi,
Bihar, *November 22, 1966.*

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TERTIARY BEDS OF KANOJ-SEHE AREA, WESTERN KUTCH

THIS note records the first occurrence from India, of two genera of planktonic Foraminifera of the family Orbulinidæ. Two new species have been recorded.[1] The Tertiary rocks of Kanoj-Sehe area, Western Kutch, are being correlated with standard section from India and abroad.

Systematic collections and geological mapping were carried out in an almost continuous section of the Tertiary strata exposed in the Kanoj-Sehe stream passing near the villages of Kanoj (23° 41′ : 68° 35′) and Sehe (23° 39′ 47″ : 68° 31′ 35″) in the vicinity of Narainsarowar (23° 41′ : 68° 32′) in Western Kutch. The beds have a low dip of about 2° to 3° towards north-west.

Stratigraphical and palæontological work on the Tertiary rocks of Kutch has been carried out by several geologists. Among important stratigraphic workers mention may be made to Carter,[2] Wynne,[3] Grant,[4] Nuttall,[5] Tewari[6] and Biswas.[7] The following sequence of beds has been observed in the Kanoj-Sehe stream section :

Bed 6.   Yellow and cream-coloured limestones, sandy clays and brown sandstones, which are about 50′ to 55′ in thickness containing *Spiroclypeus ranjanæ, Miogypsinoides dehaarti, Alveolinella* sp., *Austrotrillina howchini,* and Bryozoans and Corals.

Bed 5.   Green mudstones and shales with inter-calations of hard foraminiferal limestones. The bed is about 60′ in thickness and has yielded *Nummulites intermedius, N. clipeus, N. subclipeus, N. fichteli, Linderina* cf. *kutchensis, Lepidocyclina (Eulepidina) dilatata,*

Anomalinella rostrata, Gypsina globulus besides Molluscs, Echinoderms, Bryozoans and Corals.

Bed 4.   Cream coloured limestones and greenish shales characterised by the abundance of glauconite and presence of higher percentage of iron minerals. The bed measures about 30′–35′ in thickness and has yielded various reticulate *Nummulites, Heterostegina* sp., *Gypsina globulus* and *Archias* sp.

Bed 3.   Soft yellowish foraminiferal marl with abundant *Alveolina elliptica.* The bed is about 35′ in thickness and contains typical larger Foraminifera of the Kirthar Stage together with *Carpenteria* sp. and *Spiroloculina* sp. Specimens of *Globigerina* and *Globigerinatheka* have not been met with.

Bed 2.   Somewhat yellowish-white compact foraminiferal limestones measuring about 125′ in thickness. The bed contains, besides characteristic larger Kirthar Foraminifera, *Globigerinatheka kutchensis, Globigerina præbulloides occlusa, G. angustiumbilicata, Globorotalia (Turborotalia) increbescens, Cibicides lobatulus, Rectoeponides* sp., *Cycoloculina annulata.*

Bed 1.   Cream-coloured compact foraminiferal limestone weathering into dirty white soft bed. It is about 55′ in thickness and contains in addition to regular Kirthar Foraminifera, *Globigerapsis indica, Globorotalia (Turborotalia) centralis, Globigerina yeguensis pseudovenezuelana.*

Out of these, Bed No. 1 is referable to Lutetian on account of the presence of *Globigerapsis indica* n. sp. and *Globorotalia (Turborotalia) centralis, Globigerina yeguensis pseudovene-zuelana.* The Bed No. 2 may be assigned to the lower part of the Auversian on account of the presence of *Globigerinatheka kutchensis* n. sp., which is restricted to *Globigerapsis semi-involuta* zone of Southern Trinidad and Lindi area (E. Africa, Banner and Blow *et al.*[8]). The Bed No. 3 which is conformable to the preceding bed has comparatively a poor assemblage and could represent the upper part of Eocene, may be the upper part of Auversian. In view of this, the Bed Nos. 1 to 3 have been referred to the Kirthar Stage (Mid. Eocene) and overlie unconformably the Deccan Traps.

The Bed Nos. 4 and 5 which are conformable with each other and overlie the Kirthar beds

unconformably are together referred to the Nari Stage. The Bed No. 4 can be referred to Lattorfian on account of the presence of abundant reticulate *Nummulites* and *Heterostegina* and the absence of *Lepidocyclina* (*Eulepidina*) *dilatata*. While the Bed No. 5 which contains in addition to reticulate *Nummulites, Lepidocyclinia* (*Eulepidina*) *dilatata* in abundance, could thus be assigned to Rupelian.

The Bed No. 6 which overlies unconformably the preceding bed has yielded typical Aquitanian assemblage and is referred to the lower part of the Gaj. Beds referable to Chattian age seem to be absent in this region.

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Centre of Advanced   B. S. Tewari.
    Study in Geology,
Panjab University, Chandigarh,
            and
Geology Department,   M. P. Singh.
Lucknow University,
Lucknow, *November* 25, 1966.

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RHYOLITE AND ALKALI BASALT FROM THE SYLHET TRAP, KHASI HILLS, ASSAM*

THE Sylhet Trap, occurring in the southern part of the Shillong plateau in Assam, has previously been described as mostly basalts with intercalated tuff beds; Palmer (1923) described andesites from the western part of the Khasi Hills. Studies during systematic mapping in 1965–66 in the Dwara and Umiew gorges, in toposheet No. 78 0/12, have led to the discovery of rhyolites and alkali basalts in addition to basalts and acid tuffs; the area, lying east of

Palmer's, does not show andesites. The 600 m. of bedded lava, exposed in the gorges, can be grouped into: (a) the lower basaltic group (300 m.), (b) the middle group of megaporphyritic alkali basalts, rhyolites and acid tuffs (150 m.), and (c) the upper basaltic group (90–150 m.).

Basalts of the Sylhet Trap can be grouped into (1) massive trap with or without amygdules and (2) amygdaloidal trap with abundant amygdules passing into a scoriaceous type. Texturally, the traps vary from tachylite through basalt to dolerite. In thin sections, the basalts show labradorite, augite, opaques, glass, rare pseudomorphs of olivine, needles of apatite and secondary minerals. The rocks are mostly microporphyritic, phenocrysts of labradorite dominating over those of augite. Phenocrysts define the porphyritic and glomeroporphyritic texture; the groundmass shows hyaline, intersertal, intergranular, sub-ophitic and ophitic textures.

Alkali basalt, in hand specimens, shows megaphenocrysts of bottle green, vitreous euhedral pyroxene (up to 1 cm. in length) with preferred flow orientations set in a greyish green aphanitic base. In thin sections, the rock consists mostly of phenocrysts of clinopyroxene (diopsidic augite) showing occasional oscillatory zoning and a few altered and resorbed hornblende crystals in a micro–crystalline groundmass. The groundmass consists of microlites of a pleochroic (in shades of yellowish green) clinopyroxene (ægirine-augite ?) showing occasional flow texture, a few anhedral, pleochroic in green, highly birefringent clinopyroxene (may be ægirine), euhedral nepheline (mostly square and rectangular, rarely six-sided) magnetite and interstitial isotropic patches of a felspathoid (analcite ?). Plagioclase is totally absent and the rock closely resembles nephelinite of the alkali basalt family.

Rhyolites consist of phenocrysts of embayed alkali felspar (some grains crypto- and microperthitic), altered oligoclase, wrecks of original quartz, fayalite pseudomorphs, decomposed biotite and magnetite in a microcrystalline base. Two distinct types of rhyolite are recognised, the difference being in the nature of the base. One type shows a groundmass with well developed flow structure defined by minute iron ore granules and abundant lens-shaped amygdules. Spherulitic structure in this type is shown by a brown, weakly birefringent, fibrous indeterminable mineral mostly bordering the phenocrysts. The other type is non-spherulitic with a devitrified microfelsitic base,

Lithic tuff, ranging in size from tuff to lapilli, consists of angular fragments of rhyolites and a few crystals of felspars in a very fine microcrystalline mosaic of devitrified glass. Vitric tuffs, showing thin stratification in the groundmass, consist mostly of angular ash fragments of oligoclase and alkali feldspar all set in a fine devitrified glassy base. Perlitic cracks and pseudomorphs of shard in the fragments and in the groundmass suggest original glassy nature.

Thus the present work on the Sylhet Trap indicates close spatial association of calc-alkaline (basalts, rhyolites and acid tuffs) and alkaline (alkali basalts) suites of rocks ; the petrogenesis is being worked out. On the basis of its hitherto known composition, the Sylhet Trap has been thought to represent the northern part of the Rajmahal Trap of Jurassic age moved east to its present position along the Dawki Tear Fault (Evans, 1964). But the absence of alkali basalt from the Rajmahal Trap as also the absence from the Sylhet Trap of freshwater plant-bearing intertrappean so characteristic of the Rajmahal lavas do not suggest that the two outcrops are parts of the same set of lava flows.

SUHAS CHANDRA TALUKDAR.

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A GOEZIINE NEMATODE FROM AN INDIAN CARP

THE intestine in one of the twenty-one specimens of *Catla catla*, from Keetham lake, yielded nearly fifty adult females of an interesting goeziine nematode [Goeziinæ (Travassos, 1919) Baylis, 1920 ; Heterocheilidæ Railliet *et* Henry, 1915]. *Goezia* Zeder, 1800, according to Yorke and Maplestone (1926), has *G. ascaroides* (Goeze, 1782) Rudolphi, 1809 from *Silurus glanis* as its type species and is characterised by the presence of a series of cuticular rings provided with backwardly directed spines. The genus has been split up into two subgenera : *Goezia* and *Pseudogoezia* by Yamaguti (1961) who has included, with the type species, six other species in the former and added another species to the type species, *G. (P.) sigalasi* of the latter. The second genus in this subfamily is *Neogoezia* Kries, 1937.

The only reference to a goeziine species from India, as cited by Baylis (1939), is of Maplestone

(1930) who has recorded a single specimen from the stomach of *Gavialis gangeticus*, suggesting that the case was possibly a 'pseudoparasite' as the species of *Goezia* have hosts in fishes.

The presence or absence of spines on the posterior borders of the cuticular rings and the œsophagus with or without a ventricular apendix posteriorly differentiate *Goezia* and *Neogoezia*. The absence of spines and the absence of a single or double ventricular appendage are included in the generic diagnosis of *Neogoezia* by Yamaguti who puts a question mark regarding the presence of intestinal cœca. *Neogoezia*, according to Skrjabin and Schikbobalov (1951), was a synonym of *Goezia*. Yamaguti, on the other hand, believed that the unspined character and the absence of œsophageal appendix were important criteria to justify the retention of this genus in which the male was unknown.
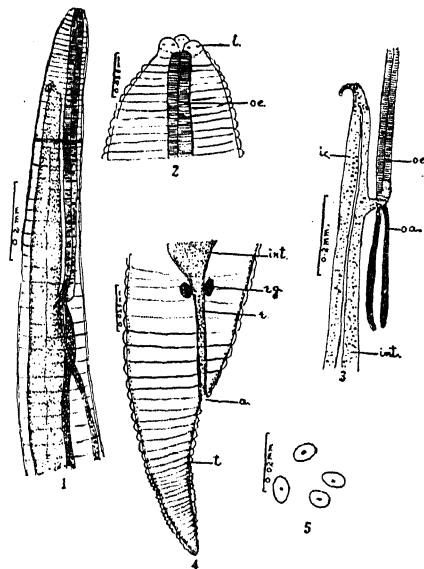
FIGS. 1–5. *a.*, anus ; *i.c.*, intestinal cæcum ; *int.*, intestine ; *l.*, lip ; *oa.*, œsophageal appendix ; *oe.*, œsophagus ; *r.*, rectum ; *rg.*, rectal gland ; *t.*, tail.

The small-sized worms, 4·65–5·61 mm. in length and 0·25–0·27 mm. in maximum breadth, had the bluntly rounded anterior end surrounded by three prominent lips—each carrying two papillæ (Fig. 2). The cuticle had well-developed striations/rings which were quite close in the anterior and posterior regions but in the middle of the body, at 0·12–0·20 mm. apart, were completely devoid of spines. The elongated and muscular œsophagus, 0·78–0·82 mm. in length, opened laterally into the thin-walled and wide intestine and, at its posterior border, gave off the two tubular and posteriorly-directed

appendages of 0·81–0·86 mm. length (Fig. 3); the intestinal cæcum, in front of its junction with the œsophagus, continued forwards as a blind diverticulum with its tip extending to 0·25–0·28 mm. distance behind the anterior end (Fig. 1). The rectal region, in front of the anus, had two rectal glands; the tail, with a tapering tip, measured 0·08–0·10 mm. in length (Fig. 4). The vulva, at 1·88–2·00 mm. distance from the anterior end, continued into a short but narrow and forwardly-directed vagina which, after curving for some distance, opened into the two uteri, one directed anteriorly and the other posteriorly—the two limbs continuing into the two ovaries which tend to pass forwards to near the anterior extremity. The thin-walled uterine eggs measured $0·0078–0·0080 \times 0·0030–0·0039$ mm. in size (Fig. 5).

The specimens, on account of the unspined feature of the cuticular rings and the double character of the œsophageal appendage, can neither be included under *Goezia* nor under *Neogœzia*. The concept of these two genera, on this distinction, is thus nullified. We agree with Skrjabin and Schikhobalov (1951) in merging *Neogœzia* as a synonym of *Gœzia*. A specific identification of these specimens has to await the discovery of males. The present observation also records the finding of a gœziine representative in *Catla catla* in which, as far as could be ascertained, adult nematodes do not seem to have yet been reported.

I am grateful to Dr. B. P. Pande for guidance.

Department of Parasitology,   P. RAI.
U.P. College of Veterinary,
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HISTOPATHOLOGY OF PARAFILARIASIS IN MULES

PARAFILARIASIS or "summer bleeding" occurring in spring and summer, is an important filarial disease of equines and bovines caused by species of *Parafilaria* Yorke and Maplestone, 1926. *P. multipapillosa* (Condamine and Drowilly, 1878) occurs in equines, *P. bovicola* Tubangui, 1934, in cattle and *P. sahaii* Srivastava and

Dutt, 1959, in buffaloes. Similar conditions have also been reported in deer and Indian elephant. The causative parasites are *P. antipini* Rūkhliadev, 1947 in deer and *Indofilaria pattabiramani* Alwar, Seneviratne and Gopal, 1959 in elephant. Brief accounts of the pathology of the disease in the various domestic animals have been given by Jesuss (1934), gulati (1934), Badanin (1936), Baumann (1736), Kral and Novak (1953) and Patnaik and Pande (1963). The histopathology of the condition in Italian mules imported in India is reported in this communication. The material consisted of two lesions made available by the Officer-in-Charge, Army Remount Depot, Saharanpur. The worms were extracted from the lesions for identification and were found to be females of *P. multipapillosa*.

The sections of the lesions revealed subcutaneous granulomatous foci, with clear spaces and necrosis of cells in the centre and intense leucocytic reaction all around dominated by eosinophils (Fig. 1). No evidence of encystation or fibrous nodule formation could be seen.

FIG. 1. Mule skin, showing cutaneous breach and subcutaneous lesions due to *Parafilaria multipapillosa* (× Ca 23).

Migration tracts of the worms were evident in the cutaneous tissue which were clearly opening to the exterior through breach in the dermis and epidermis. With the course of migration, there was appreciable traumatic demage but cellular reaction was not much, and no micro-

ariæ or embryonated eggs were found.
cepting for the breach in the cutaneous layers
re, the adjoining dermal as well as epidermal
'ers did not show any significant change.
subcutaneous tissues, however, the blood
ssels were much congested and arteries were
ckened, and there was invariably intense
ivascular eosinophilic infiltration around all
all or big blood vessels (Fig. 2). Since the
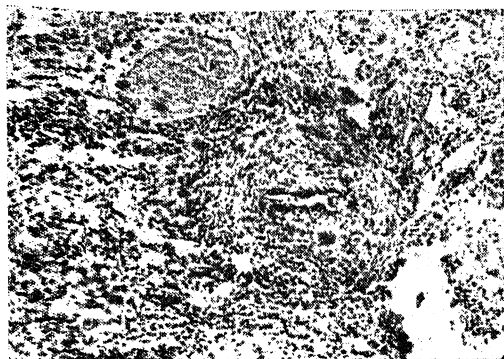
G. 2. Mule skin, showing thickening and conges-
of subcutaneous blood vessels, and intense
ascular eosinophilic infiltration due to *P. multipapillosa*
Ca 100).

sites were already taken out from these
ns, no worms or their microfilariæ or
ryonated eggs could be detected in the
ions. The skin fistula described by Badanin
6) in case of *P. bovicola* infection was not
ent here. Larvæ, as seen by Romanowitsch
4) in the blood vessels, were also not
rved.
ie present observations indicated that
multipapillosa does not cause any significant
lar changes in the cutaneous layers, except
the breach in them for the purpose of
osition by the female. The worms probably
iot remain localised in a particular site in
subdermal tissue, giving no chance for their
psulation ; they possess considerable free-
to move to the surface of the skin for
ofilarial discharge, and return to subdermal
e again (Heinrich, 1924). The nodules on
surface of the skin described in this infec-
by earlier authors are probably hæmor-
ic vesicles resulting from rupture of
laries of the papillary dermis caused by
migrating worm. Subsequently when the
ermis is punctured by the worm in the
ss of its oviposition, these vesicles bleed.
iermore, these *Parafilaria* worms in the
itaneous tissues appear to liberate some
of potent toxin, which when absorbed by
blood vessels of the area incites intense

perivascular cellular reaction and also causes
induration of the local arterioles.

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Division of   V. P. Sharma Deorani.
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Indian Veterinary
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EFFECT OF D-CYCLOSERINE ON THE DEVELOPING CHICK EMBRYO

Antibiotics are sometimes responsible for
congenital abnormalities as well as toxic effects
on the central nervous system. The congenital
abnormalities were thoroughly investigated for
antibiotics like actinomycin D[1,6] and tetra-
cycline.[2,3] D-cycloserine on the other hand which
was found to be responsible for toxic action on
the central nervous system[4,5,7] has not been
investigated as an inducer of congenital
abnormalities. Accordingly, this investigation
was carried out.

Fertilized white Leghorn eggs were injected
after 24 hours incubation with ½ c.c. distilled
water containing 5 mg. D-cycloserine (Hoffman-
La Roche and Co.) and then re-incubated for
further 24, 48 and 72 hours before examination.

Figure 1 shows the abnormalities induced by
D-cycloserine on a chick embryo aging 96 hours.
Distinct abnormality regarding the phenotype
was observed. The blastoderm showed acute
atrophy with subsequent reduction of the size
of the embryo itself. The embryo also lacked
the ability to perform the processes of flexion
and torsion and persisted at the longitudinal
axis in a form far from the characteristic
C-shape of this stage. Moreover, relatively large
œdimic vesicles OD.V. filled with an œdimic
fluid were found in different parts of the body.

The brain also showed severe retardation ;
the prosencephalon PROS. was still undifferenti-
ated, the mesencephalon MES. was slightly
demarked from the prosencephalon by a shallow

depression and the rhombocephalon was feebly differentiated into the meten MET. and the myelencephalon MY. The neural tube N.T. showed abnormal zigzag pathway. As a matter of fact it is less zigzagged than in the previous stages of treated embryos. This might be due to either the elongation gained by the embryo or the rigidity induced by the propagating œdimic vesicles surrounding the tube, or both. Of the special sense organs only the eyes EYE and the auditory pit AUD.P. could make appearance. The olfactory pit on the other hand, failed completely to develop. However, the right eye appeared older than the left.
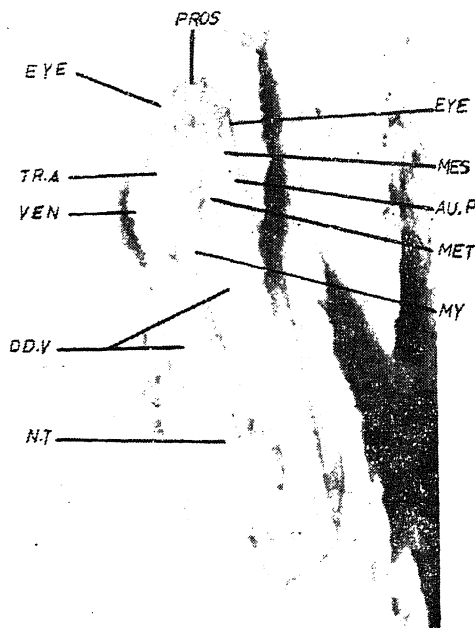
FIG. 1

The heart occupied a deviated position, being localised on the left hand side. Moreover, it showed only two chambers; the truncus arteriosus T.A. and the ventricle VEN. The atrium on the other hand could make no appearance. Similarly, no definite aortic arches characteristic of this stage were observed and the heart remained in close contact to the body of the embryo. The antibiotic also blocked the connection between the extra asd intra-embryonic circulation in view of the complete absence of omphalomesenteric arteries and veins.

The effect was most pronounced however, on the body musculature; complete resorption of previously existing mesoblastic somites in 48 and 72 hrs. treated embryos had been achieved.

The resorbed somites were replaced by the propagating œdimic vesicles. Furthermore, no sign of either posterior or anterior hind limbs was traced.

ABDEL HALIM KAMEL.

EZZ ELDIN SAID HUSSAIN.

ELSAYED MAHAMMED HAMMOUDA.

Dept. of Zoology,
Faculty of Science, Ain Shams Univ.,
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ANTENNAL PULSATILE ORGANS IN *SCOLOPENDRA MORSITANS* (CHILOPODA: MYRIAPODA)

IN the course of our studies on the cardiac physiology of myriapods[1,2] it was observed that during the periods of asystole, heart-beats started whenever the antennæ were moved voluntarily and they stopped with the cessation of antennal movements, in chilopod *Scolopendra morsitans*. Since there is no anatomical attachment of antennal muscles to those of the heart in chilopods,[1] two methods of investigations were undertaken to find out the relationship between the antennal movements and the stimulation of heart-beats : (*a*) Examination of serial sections of the head and antennæ, stained in Heidenhain's hæmatoxylin followed by eosin, and (*b*) tracing the course of blood in the cephalic and antennal hæmocœlic channels with the aid of vital stains. The dyes used were trypan blue and biebrich scarlet dissolved in chilopod physiological saline.[1] These investigations revealed the presence of antennal pulsatile organs with muscular attachment to the anterior extensions of the heart (aorta), as in some insects.[3] Movements of the antennæ caused beating of these accessory pulsatile centres which in their turn stimulated heart-beats. Since this was the first record of accessory pulsatile organs in Myriapoda, a detailed study of the structure of these organs was undertaken. The following is the description of these accessory pulsatile centres and associated structures in *Scolopendra morsitans*.

The pulsatile organs are in the form of a pair of small ampullæ situated immediately below the epidermis which lines the frons (Figs. 1 and 2). A tube extends from each of the ampulla
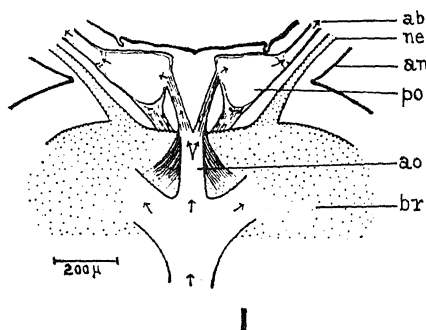
FIG. 1. Ventral view of the antennal pulsatile organs and anterior extensions of aorta in *Scolopendra morsitans*. Blood flow indicated by arrows. (*ab*, antennal blood vessel; *an*, antenna; *ao*, aorta; *br*, brain; *ne*, antennal nerve; *po*, pulsatile organ.)
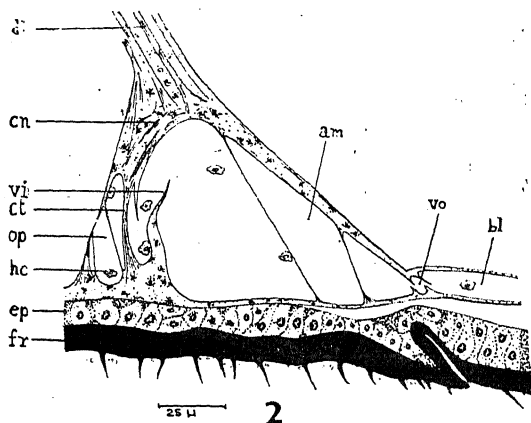
FIG. 2. Horizontal section of an antennal pulsatile organ in *Scolopendra morsitans*. (*am*, ampulla; *bl*, antennal blood vessel; *cn*, cnstrictors; *ct*, connective tissue strands; *dl*, dilators; *ep*, epidermis, *fr*, frons; *hc*, hæmocyte; *op*, median opening; *vi*, valve into the ampulla; *vo*, valve out of the ampulla.)

to the most distal segment of every antenna. The walls of the ampulla are double-layered, membranes of connective tissue (Fig. 2). Between the layers of the connective tissue is a thin layer of lightly granular cytoplasm in which nuclei are scattered. The membranes form a tent-like structure narrowing towards the base of the antenna. There is an opening on the median side of each ampulla into the hæmocœl, through a vertical slit, which opens into the lumen of the ampulla through a flat valve. The slit and the valve are held in posi-

tion by connective tissue strands stretched across the opening. There is a second valve on the lateral side of the ampulla at the base of the tube leading into the antenna (Fig. 2). This is a single-pocket valve allowing the blood to flow out of the ampulla but not back into it. A few connective tissue strands extend across the lumen of the pulsatile organs (Fig. 2).

Between the outer and inner connective tissue membranes of the walls of the ampulla are two sets of muscle fibres. These are: inner circumferential fibres of the ampulla which may constrict its lumen; and outer longitudinal fibres which originate in the anterolateral surface of the brain and insert on to the dorsal and posterolateral surfaces of the ampullæ. These may dilate the ampullæ. The dilator muscles are easily seen with polarized light while the constrictor muscles are much finer and extremely difficult to see.

The ventral wall of the aorta extends anteriorly through the circumœsophageal nerve ring as a muscular sheet. This divides immediately anterior to the brain and each branch is inserted on one of the antennal pulsatile organs just below their openings. Inserted above the opening of every pulsatile organ are muscle fibres arising from the ventral surface of the connective tissue sheath of the brain. These two groups of muscle fibres are enclosed in a connective tissue membrane forming a tubular blood vessel which extends in between the aorta and the openings of the antennal pulsatile organs (Fig. 1).

The above description of the antennal pulsatile organs in *Scolopendra morsitans* interestingly recalls that of *Sialis lutaria*, the alder fly.[4]

Department of Zoology,   G. SUNDARA RAJULU.
Thiagarajar College,
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COWPEA—A LOCAL LESION HOST FOR PEA MOSAIC VIRUS

SREENIVASAN AND NARIANI[1] reported the occurrence of a mosaic disease of pea (*Pisum sativum* L.) from India and on the basis of their studies on transmission, host range and physical properties they identified the virus as a strain of *Pisum* virus 2 A. In a search for a local lesion host for this virus it was observed that some varieties of cowpea (*Vigna sinensis* Savi.) produced distinct countable local lesions on the inoculated cotyledonary leaves (Fig. 1). Experiments were carried out to determine the utility of the cowpea variety *Pusa Phalguni*, as a local lesion host and the properties of the virus using this host were examined.
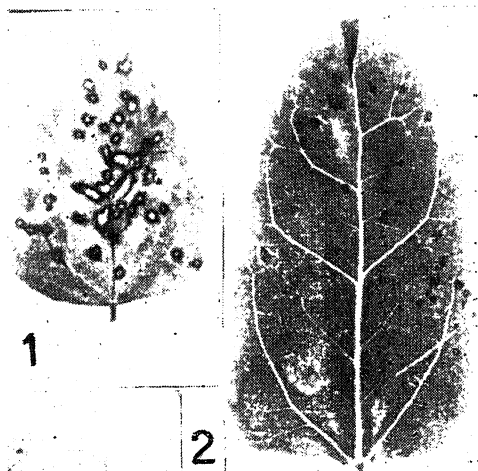
FIG. 1. Necrotic local lesions due to pea mosaic virus (*Pisum* virus 2 A) on cowpea varieties (1) I-C 8267, (2) Pusa Phalguni.

The culture of the virus was maintained on broad bean (*Vicia faba* L.) plants. The sap obtained from infected leaves of broad bean served as inoculum. The test plants of cowpea variety, *Pusa Phalguni*, were raised in 4-inch pots filled with sterilized soil and kept inside the insect-proof glass–house. Inoculations were made when the cotyledonary leaves were fully opened. In the first experiment dilution-end-point of the virus was studied by inoculating the test plants with the inoculum diluted to different concentrations in distilled water, and it was observed that the end-point was between 1 : 3000–5000.

In another experiment the thermal death point of the virus was determined by inoculating cowpea plants with the inoculum exposed for ten minutes to different temperatures, and it was found that the thermal death point ranged

between 60° and 65° C. These properties are slightly in variance with those reported by Sreenivasan and Nariani[1] and this may be due to use of inoculum from broad bean instead of pea and also use of more sensitive local lesion host. Cowpea varieties have been reported to produce necrotic local lesions when infected with strains of cucumber mosaic virus,[2-4] alfalfa mosaic virus from potato,[5] foliar necrosis and interveinal chlorosis of tomato[6] and potato virus Y.[7] The results reported here suggest that cowpea variety *Pusa Phalguni* can be used for the bioassay of pea mosaic virus *Pisum* virus 2 A and this is the first report of cowpea as a local lesion host for pea mosaic virus.

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OCCURRENCE OF ACCESSORY CHROMOSOMES IN *PANICUM MAXIMUM* JACQ.

Panicum maximum is a complex taxon comprising several distinct forms with chromosome numbers as $2n = 18, 36, 32$ and 48 (*see* Carnahan and Hill, 1961). While carrying out cytotaxonomic investigations in 20 collections ($2n = 32$) of this grass, the presence of accessory chromosomes was encountered in the collections from Assam and Bengal. So far as known to the author this is the first report on the presence of accessory chromosomes in *P. maximum*.

The number of accessory chromosomes in P.M.C.'s of *P. maximum* varied from 0 to 5, though the cases with 5 accessories were rather rare. The accessory chromosomes did not show any pairing between themselves as was earlier observed in *P. coloratum* (Jauhar, 1963). At metaphase I, when the normal chromosome configurations oriented themselves at the equator, the accessory chromosomes showed a tendency to go towards the periphery (Fig. 1). At anaphase and telophase I, the accessory univalents generally divided (Fig. 2), the products

getting included at random to the two poles. Sometimes the distribution of the accessories to the two poles was equal but quite often all of them moved to one pole only.
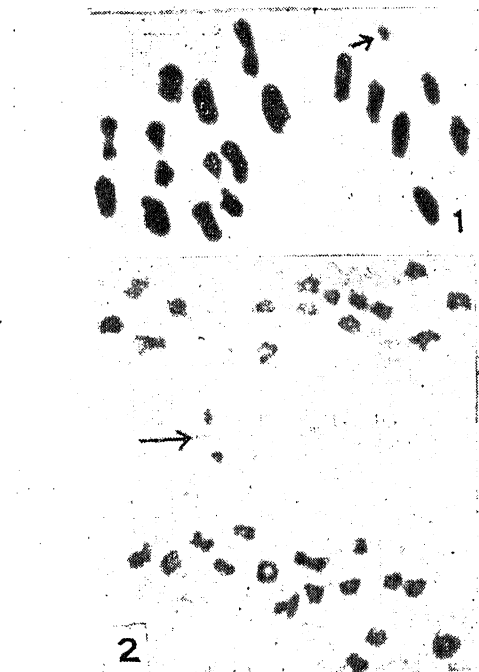
FIGS. 1-2. Fig. 1. Metaphase I showing one accessory chromosome (arrow). Fig. 2. Anaphase I showing one dividing accessory chromosome (arrow).

In *P. maximum* accessory chromosomes appear to have arisen from the normal chromosomes and seem to be of significance from evolutionary standpoint. Because of the predominance of $x = 9$ for the entire genus *Panicum*, it appears likely that in *P. maximum*, $x = 8$ might have been derived from a higher number and possibly from forms with $x = 9$ as the basic number, especially in view of the fact that diploid form of *P. maximum* is reported to possess $2n = 18$ chromosomes (de Wet, 1954). The present forms of this species with $2n = 32$ chromosomes appear to owe their origin to autotetraploidy followed by chromosome reduction and the accessory chromosomes are the by-products of such reduction.

It is significant to note that as early as 1954, Virkii visualized that in animals accessories may be formed as a by-product when species formation is associated with a change from a higher to a lower chromosome number. Carnahan and Hill (1961) were also of the view that the presence of accessory chromosomes may represent a stage in the evolution to a

higher or a lower basic chromosome complement. Another point of interest is that, unlike in *P. coloratum* (Jauhar, 1963), the accessory chromosomes in *P. maximum* do not pair between themselves nor do they show any affinity with the normal chromosomes. It would appear, therefore, that the accessories in this species have had an ancient origin and have undergone differentiation in the course of evolution. The presence of such accessory chromosomes could be plausibly treated as evidence of reduction in chromosome number during the evolution of *P. maximum*.

I am grateful to Dr. A. B. Joshi, Dr. M. S. Swaminathan and Shri S. Ramanujam for advice and helpful suggestions during the course of this investigation.

Division of Genetics,   PREM P. JAUHAR.
Indian Agri. Res. Institute,
New Delhi-12,
November 29, 1966.

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DIOECISM AND MONOECISM AS TAXONOMIC CRITERIA IN CHAROPHYTA

IT is well known that monoecious and dioecious conditions are used as taxonomic criteria for evaluation of species both in higher as well as in lower plants. In systematics of Charophyta also these criteria have played an important role (*cf.* Pal *et al.*[1]), and several species were established on the basis of their dioecism (*e.g.*, species listed in Table I, column 1). Recently, Wood,[2] Wood and Imahori[3] have presented a new classification of Characeæ. The revision has resulted in a drastic cut in the number of species, as a result of either relegating several existing species to intraspecific level or by combining several species into one. In doing so, they considered certain criteria as of considerable importance (*e.g.*, row of stipulodes, extent of stem cortication and cortication of basal segment of the branchlet, etc.), in the delimitation of the species, while other criteria (*e.g.*, nature of stem cortication, position of gametangia and sex, etc.), were not considered to be so important. Monoecious and dioecious conditions, in their opinion, are not to be considered as important criteria as they "reflect minor genetic variation". They also considered that dioecious taxa represent genetic strains of monoecious

taxa with half the usual chromosome complements characteristic of the latter (Wood and Imahori,[3] p. 17). Following this concept, they have either completely merged several dioecious species with morphologically similar monoecious species or reduced the former to intraspecific levels of the latter. A few such cases are illustrated in Table I.

TABLE I

Morphologically similar species of Nitella *and* Chara

Dioecious taxa	Monoecious taxa	Combination by Wood and Imahori[3]
1. *N. opaca* (Bruz.) Ag. $n = 6$	*N. flexilis* (L.) Agardh. $n = 12$, Sawa[4]	*N. flexilis*
2. *N. flagelliformis* Br. $n = 9$	*N. furcata* Roxb. ex Bruz. $n = 18$	*N. furcata* subsp. *flagelliformis*
3. *N. globulifera* Pal. $n = 9$	*N. gracilis* (Sm.) Ag. $n = 18$, Tindal and Sawa[5]	*N. gracilis* var. *leptosoma*
4. *N. annandalei* Pal. $n = 9$	*N. gracilis* (Sm.) Ag. $n = 18$, Tindal and Sawa	*N. gracilis* var. *annandalei*
5. *Chara wallichii* Br. ex Nord. $n = 14$	*C. corallina* Klein ex Willd. $n = 42$	*C. corallina* var. *wallichii*

In a recent study of the cytotaxonomy of *N. flexilis* (a monoecious form) and *N. opaca* (a dioecious form), Sawa[4] has demonstrated that *N. flexilis* with a chromosome number of $n = 12$ might have arisen through hybridization between *N. opaca* with $n = 6$ and another unknown species also with $n = 6$. This conclusion was based on the observation that 6 chromosomes of *N. flexilis* are nearly identical with 6 of *N. opaca*, while remaining 6 chromosomes are not homologous with those of the other set. These findings of Sawa,[4] which imply clearly that *N. opaca* is quite a distinct species from *N. flexilis*, do not give support for the merger of the former with the latter as was done by Wood and Imahori.[3] *N. opaca* is, therefore, not to be considered as a dioecious member of the complex, simply because it has half the number of chromosomes as that in *N. flexilis*.

Recently while investigating the cytology and cytotaxonomy of Indian Charophyta (Sarma and Khan[6]), we came across with many species of both *Nitella* and *Chara* including several dioecious and monoecious taxa.

The cytotaxonomic studies of the authors on *N. opaca*, *N. flagelliformis*, *N. globulifera*,

N. annandalei and *Chara wallichii* (the details of which will be published elsewhere) have shown that these taxa not only differ in chromosome numbers but also in karyotype organisation. Further, they have also been observed to differ in some of their morphological characters from their monoecious counterparts, with which the former have been combined (*cf.* Table I). Similar observations were also made by Tindal and Sawa[5] with respect to *C. evoluta* and *C. canescens*.

The morphological similarities between the dioecious and monoecious species on the basis of which new combinations were made by Wood and Imahori[3] might be due to parallel evolution rather than being genetic. Moreover, the generalization of Wood and Imahori[3] that monoecious taxa have double the chromosome number as compared with dioecious forms within a complex, does not get support from cytological findings of the authors that the chromosome number of *C. corallina* ($n = 42$) is thrice that of *C. wallichii* ($n = 14$). It is relevant to mention here that Sundaralingam[7] has also concluded on the basis of developmental morphology that the two species *C. corallina* and *C. wallichii* are distinct.

The view put forth by Forsberg[8] on the basis of critical morphological studies that the differences between monoecious and dioecious taxa are "more than genetic variation" in *C. globularis* and *C. aspera* is fully supported by our cytotaxonomic studies on other taxa referred to above.

Thus it can be concluded that monoecious and dioecious conditions are important criteria in specific delimitation of Characeæ from a cytological viewpoint. The dioecious taxa should not be considered as mere genetic strains of morphologically similar monoecious taxa with half the usual chromosome complement as was advocated by Wood,[2] unless cytological evidence also leads to such a conclusion.

It, therefore, seems reasonable to recognise *N. opaca*, *N. flagelliformis*, *N. globulifera*, *N. annandalei* and *Chara wallichii* as independent species.

Department of Botany,   Y. S. R. K. SARMA.
Banaras Hindu University,   M. KHAN.
Varanasi, India,
November 17, 1966.

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CYPERUS CIRCINATUS RIDL.— AN ADDITION TO INDIAN FLORA

THIS elegant *Cyperus* was met with only in clefts of rocks, on the peak and slopes of Binsar and Cheena, Almora (U.P.) and pre-summit plateau on marshy ground or stagnant water after rains in form of thick, compact, dark green cushions up to 2-8 cm. in diameter during a botanical excursion in October 1964. The plant is a delicate herb with tender trique-trous, culms terminating in 2-8 little umbels subtended by 3-4 unequal rays (Fig. 1). The
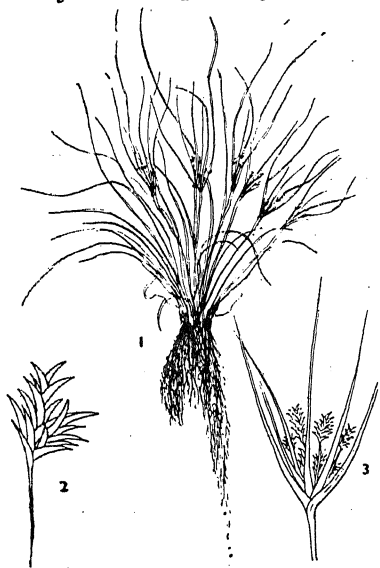
FIGS. 1-3. *Cyperus circinatus* Ridl. Fig. 1. The entire plant from the colony, × Natural Size. Fig. 2. A mature spikelet, × 6. Fig. 3. An umbel from the ray, × 4.

slender spikelets have the flowers distant and the glumes curiously curled at the apex. The spikelets are in reality the spike and bear 16-20 sessile florets (Shah, 1962). Each spikelet has 5-8 markedly unequal glumes on a shortened rachilla. The sinuate rachilla is covered by the sheathing glume bases. Each floret has a single stamen and a carpel with two styles arising from the apex of the ovary to end in violet feathery stigmas. The glumes are winged

on the keel and have a recurved mucro. The keel envelopes the nut. The nut is rather long and almost terete showing little traces of bicon-vexity. The brown wiry roots emit an aroma when crushed.

The late Professor H. N. Ridley, with his student Mr. C. A. Ramage of Edinburgh, started for Brazil on July 9th, 1887, to thoroughly explore the island of Fernando Noronha lying in long. 32° 25′ 30″ W and lat. 3° 50′ 10″ S at a distance of 194 miles N.E. from Cape San Roque coast of Brazil and reported the species from the slopes of Morro branco in 1891. Since then, it finds no mention in the literature on the Cyperaceæ. Neither the plant has been reported from India by Roxburgh (1820–74), Hooker (1882–97), nor by Cooke (1901–08), Gamble (1915–36), Kanjilal (1934–40) and Blatter and McCann (1934, 1935). Kükenthal (1935–36) treated it as a variety of *C. poly-stachyos* Rottb. But *C. circinatus* is specifically distinct as shown below :

Outer cells of the nut surface hexagonal, rachilla winged, glumes uniform, without a mucro, stamens 2, anthers small oblong, leaf apex linear, lamina broad, nut biconvex ....*C. polystachyos* Rottb.

Outer cells of the nut surface oblong, rachilla wingless, glumes markedly unequal with a mucro, stamen 1, anthers capitate, leaves circinate and filiform, nut oblong, terete (modi-fied from Ridley, 1891) ......*C. circinatus* Ridl.

It seems impossible for phytogeographical reasons that a species only known from Fernando Noronha has a *second* station in the mountains of India. It is a foreign plant which has not yet been reported from India. If it is a native of India, it will be noteworthy as the flora of India is closely related to that of North-Africa but is different from eastern Asiatic flora. There is no sheet either at Rijksherbarium, Leiden or Central National Herbarium, Calcutta.

Botany Department,   C. K. SHAH.
Gujarat University,
Ahmedabad-9, *February* 28, 1967.

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REVIEWS AND NOTICES OF BOOKS

Internal Factors in Evolution. By Lancelot Law Whyte. (Tavistock Publications, 11, New Fetter Lane, London EC 4), 1965. Pp. xxii + 81. Price 18 *sh.* net in U.K. only.

As a result of recent developments in molecular biology, a school of thought has been developing since 1940 which seeks to complement the Darwinian principle of external adaptive selection by a new type of selection acting directly on mutations inside the organism at the molecular and chromosomal levels. Under this principle, random mutations are subjected to a selection process dependent on their compatibility with the internal organization and processes of the organism, before the adult faces environmental competition.

In its emphasis on biological order, co-ordination, and organization, as having equal importance with random statistical competition, this concept is, in a radical philosophical sense, complementary to Darwin's principle, and for this reason carries significant implications for the psychological and social sciences, which have developed under the influence of Darwinian ideas, as well as for the biological sciences.

C. V. R.

Control of Energy Metabolism. Edited by Britton Chance, Ronald W. Estabrook and John P. Williamson. (Academic Press, New York and London), 1965. Pp. xii + 441. Price $10.50.

This book represents the proceedings of a Colloquium on Metabolic Control, Johnson Research Foundation, Philadelphia, May 20, 1965 and a Symposium on Control of Energy Metabolism, Philadelphia, May 21, 1965 in celebration of the Bicentennial of the University of Pennsylvania School of Medicine. The contents of this book are as follows : I. Theoretical Aspects of Control Properties in Enzyme Systems ; II. Computer Studies ; III. Phosphofructokinase : Its Purification, Crystallization, and Kinetic Properties ; IV. Enzyme Profile Patterns and Reconstituted Systems ; V. Control in Single-Cellular Systems Due to P_1 or ADP Availability ; VI. The Role of Cations in Metabolic Control ; VII. Control Due to Changes of Enzyme Content ; VIII. Regulation of Glycolytic Activity in Smooth and Skeletal Muscles ; IX. Regulation of Metabolism in

Brain ; and X. Regulation of Glycolytic Activity in Heart Muscle.

C. V. R.

Annual Review of Astronomy and Astrophysics (Vol. 4). Edited by Leo Goldberg. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306, U.S.A.), 1966. Pp. vii + 513. Price $8·50 (U.S.A.) and $9.00 (elsewhere).

The contents of this volume are listed below : Abundance Determinations from Stellar Spectra, by R. Cayrel and G. Cayrel de Strobel ; The Long-Period Variable Stars, by Jozef I. Smak ; Problems of Close Binary Systems that Involve Transfer of Angular Momentum, by Su-Shu Huang ; The Accuracy of Trigonometric Parallaxes of Stars, by S. Vasilevskis ; Absolute Intensity Calibrations in Radio Astronomy, by J. W. Findlay ; Magellanic Clouds, by B. J. Bok ; The Structure of Radio Galaxies, by Alan T. Moffet ; Evolution of Protostars, by Chushiro Hayashi ; Astronomical Measurements in the Infra-red, by Harold L. Johnson ; Hydrogen Molecules in Astronomy, by G. B. Field, W. B. Field, W. B. Somerville, and K. Dressler ; The Polarization of Cosmic Radio Waves, by F. F. Gardner and J. B. Whiteoak ; Magnetic Stars, by P. Ledou and P. Renson ; Pulsation Theory, by R. F. Christy ; Superdense Stars, by John Archibald Wheeler ; Spectral Classification through Photoelectric Narrow-Band Photometry, by Bengt Stromgren ; and Related Articles Appearing in Other *Annual Reviews*.

C. V. R.

Advances in Space Science and Technology (Vol. 8). Edited by Frederick I. Ordway, III. (Academic Press, New York and London), 1966. Pp. xiv + 396. Price $16.00.

Volume 8 of this well-known series contains the following articles : The Concept of Volcano-Tectonic Undation in Selenology, by G. J. H. McCall ; Structure and Materials for Solid Propellant Rocket Motor Cases, by Charles W. Bert and Walter S. Hyler ; Selection of Carrier Vehicles, Spacecraft, and Missions for Exploration of the Solar System, by George W. Morgenthaler and George E. Fosdick ; and The Use of Mars and Phobos to Advance Interplanetary Flight, by Ernst A. Steinhoff.

C. V. R.

Modern Electronics. By H. De Waard and David Lazarus. (Addison Wesley Publishing Company, Inc., 10–15, Chitty Street, London W. 1), 1966. Pp. ix + 358. Price $ 7.00.

This book, treating the basic physics of electronic devices and circuits, can be used as a text for undergraduates in physics or engineering and as a self-teaching device for engineers and scientists who wish to learn electronics to better understand how it affects their work. The purpose of the book is to convey practical information about electronic circuits and to create an understanding of their limitations.

The integrated treatment of tube and transistor circuits points out the benefits and deficiencies of each. Many circuits are given with complete details so that they can be successfully copied.

General physics, calculus, and simple ac and dc circuit theory are desirable prerequisites.

C. V. R.

Pollen Grains of Western Himalayan Plants. By P. K. K. Nair. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), Pp. 102. Price Rs. 16·00.

This monograph embodies the pollen morphology of Western Himalayan flora covering 5 families of Gymnosperms, 82 of Dicots and 10 of Monocots. The book contains photomicrographs of 197 species.

Elementary Principles of Plant Breeding. By H. K. Chaudhari. (Author's Publication Available from Jain Brothers, Babu Bazar, Udaipur), Pp. 292. Price Rs. 10·00.

This is a cheap compilation of topics on plant breeding by a teacher of the subject in an agricultural institution. It is intended to meet the needs of an average B.Sc. Ag. student.

Publications of the Central Board of Irrigation and Power, New Delhi

1. Development of Irrigation in India. By K. L. Bhatia.
2. Administration and Financing of Irrigation Wotks in India. By N. D. Gulhati.
3. Irrigation Research in India. By D. V. Joglekar.

On the occasion of the Sixth Plenary Session of the International Commission on Irrigation and Drainage held in India in January 1966, the C.B.I.P. has brought out the above informatory books. In the first book the author gives a panoramic view of the development of irrigation in India from the earliest times, and includes a chapter on Major Developments

under the Five-Year Plans since 1950. In the second book N. D. Gulhati gives factual accounts of the present practices regarding administration and financing of irrigation works in the country, a brief history of the developments leading to these practices, and a general appraisal of the system with useful suggestions for future developments. The book by D. V. Joglekar highlights the various aspects of hydraulic and allied researches on river valley projects.

A. S. G.

Elements of Probability Theory. By J. Bass. (Academic Press, Inc., 111, Fifth Avenue, New York), 1966. Pp. 250. Price $ 9.75.

This is an English translation of the original French book by Prof. Bass. The book develops a broad grounding in probability theory, extends it to stochastic processes, and then goes on to an exposition of the most commonly employed statistical methods. It is a good text to obtain basic knowledge on probability theory enabling the student to pursue the subject in any specialised field of application. A. S. G.

An Introduction to Computer Programming. By Henry Mullish. (Gordon and Breach, Science Publishers, Inc., New York), 1966. Pp. 244.

This introductory book is intended to introduce to the reader—layman and student alike—the essentials of programming for electronic computers. The language used in the text is FORTRAN. The text is supplemented by a number of coding sheets which will provide exercises for a serious student to become well acquainted with the art of programming.

A. S. G.

Books Received
Recent Advances in Biological Psychiatry (Vol. VIII). Edited by J. Wortis. (Plenum Press, New York), 1966. Pp. xiii + 367. Price $ 12.50.
The Development of High Energy Accelerators. By M. Stanley Livingston. (Dover Publications, New York), 1966. Pp. xi + 317. Price $ 2.50.
Metallurgical Society Conferences (Vol. 32). Edited by L. McDonald Schetky and Henry A. Johnson—Beryllium Technology—Vol. I, Pp. xii + 678. Price: Cloth $ 25.00, $ 19.00 ; Vol. II, xii + 679–1255. Price Cloth $ 35, $ 19.
Late Eighteenth Century European Scientists. Edited by R. C. Olby. (Pergamon Press, Headington Hill Hall, Oxford), 1966. v + 209. Price $ 18 *sh.* 6 *d.*

ANNOUNCEMENTS

Award of Research Degrees

Utkal University has awarded the D.Sc. Degree in Botany to Shri S. Y. Padmanabhan, Ph.D. degree to Shri S. Patnaik (Chemistry).

Andhra University has awarded the Ph.D. degree to the following: Sri. R. Ramakrishnam Raju (Chemistry), Sri. K. Murali Mohana Rao (Geo-Physics), Sri. K. Ranga Rao (Zoology), Sri. V. Visweswara Rao (Zoology), Sri. D. V. Subba Rao (Zoology), Sri. K. Satyanarayana Murty (Agriculture).

Sri Venkateswara University has awarded the Ph.D. degree to the following: Sri. K. Syamasundar (Chemistry), Sri. N. Harigopal (Botany), Sri. M. Prasada Rao (Botany), Sri. A. Venkataramaiah (Zoology), Sri. T. Gopalakrishna Reddy (Zoology).

Endeavour Prizes

The subject for the Essays for the above competition for the year 1967 are as follows: (1) The world in 2000 A.D., (2) The origin of life, (3) The Control of gene activity, (4) New constructional materials, (5) Viruses and cancer, (6) The hydrogen bond.

The essays, which must be in English and typewritten, should not exceed 4,000 words in length, and only one entry is permitted from each competitor (age under 25). The latest date for receipt of entries is 1st June 1967. The essays must be submitted without signature. The competitor's full name and address and date of birth should be disclosed in a sealed covering letter attached to the essay.

All entries should be marked 'ENDEAVOUR PRIZE ESSAY' and addressed to: The Deputy Secretary, British Association for the Advancement of Science, 3 Sanctuary Buildings, Great Smith Street, London S.W. 1.

Rodent Literature

A very limited number of copies of "A Bibliography of Rodent Literature with Emphasis on India" is available free of charge to rodent researchers. Write: Attn: Miss P. S. Padmini, Johns Hopkins CMRT, c/o. All India Institute of Hygiene and Public Health, 110, Chittaranjan Avenue, Calcutta-12.

On the Use of Transistor Diode in A. C. Bridge Measurements

Sri. G. M. Sreekantath, Professor of Physics, Mahatma Gandhi College, Trivandrum-4, writes:

Measurements of inductance, capacitance and conductivity of solutions are made by A. C. Bridges, in this College using very simple equipment such as a Bell Transformer giving 3 volts A.C. (50 cycles) as the A.C. source and a transistor diode put in series with a moving coil mirror galvanometer as the detector instead of the conventional Audio-oscillator and Headphone respectively. The equipment is inexpensive and the accuracy obtainable is much greater.

Fifth Seminar on Documentation Research

The Documentation Research and Training Centre (DRTC) is sponsored by the Indian Statistical Institute for the purpose of conducting research and to provide advanced training to post-graduates in documentation work and service, in order to meet the needs of research institutions and industries. One of the objectives of the DRTC is to convene annual seminars turned on specific topics in the wavefront of thought in documentation. The Fifth Annual Seminar will be held in December 1967. Documentalists are invited to contribute papers and participate in the Seminar.

All enquiries and correspondence may kindly be addressed to the Convener, A. Neelameghan, Documentation Research and Training Centre, 112 Cross Road 11, Malleswaram, Bangalore-3.

Summer School on 'Co-ordination Compounds' June 26th to July 7th, 1967

The Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12, is planning to hold a Summer School on 'Co-ordination Compounds' with the assistance of U.G.C. Lectures (about 45) will be delivered on the following topics; symmetry in co-ordination chemistry, crystal field theory, normal co-ordinate analysis, recent trends in co-ordination chemistry, polarography and potentiometry, π–linkage, liquid–liquid extraction and ion exchange, co-ordination compounds in industry, structure of complexes by electronic, infrared, N.M.R. and E.S.R. spectroscopy, dipole moments and X-ray diffraction. Practical work is planned for a limited number with the techniques available at the Institute. It is also intended to present a few original papers.

Further details can be had from Prof. M. R. A. Rao, Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12.

A NEW TYPE OF MAGNETIC MEMORY PHENOMENON IN ROCKS

C. RADHAKRISHNAMURTY AND P. W. SAHASRABUDHE

Tata Institute of Fundamental Research, Bombay-5

INTRODUCTION

IN a recent paper Likhite and Radhakrishna-murty[1] have reported the different types of low field hysteresis loops, generally known as Rayleigh loops, obtained for basaltic specimens, the most interesting one observed among them being the constricted loop. It is now well known that several magnetic alloys[2-4] and also some rocks[5-6] show major loops with constrictions which can be attributed to either the magnetic anisotropy or the presence of more than one magnetic phases in them possessing widely different magnetic properties. The constricted major loop shown by an alloy or a rock is more or less a permanent feature of the material concerned until and unless

the one reported by Blackman *et al.*[7] from studies on magnetic minerals at various temperatures using a different technique. Also this phenomenon bears a great similarity to the one observed by Brissonneau[8] during studies on magnetic diffusion after-effect in a very dilute solid solution of carbon in iron, at a temperature of $-21 \cdot 3°$ C. Nevertheless it may be clearly mentioned at the outset, that the phenomenon described herein is at room temperature and has a direct bearing on palæomagnetic measurements, which is being reported elsewhere by Radhakrishnamurty *et al.*[9]

In Figs. 1 a and 1 b are shown the two types of low field constricted loops observed in rocks. The loop in Fig. 1 a which is almost collapsed

a   b
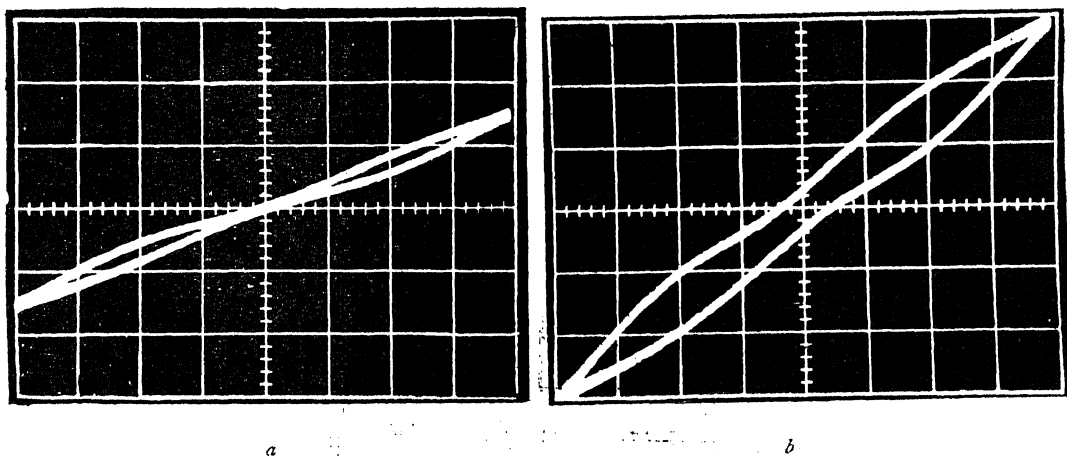
FIG. 1. Types of constricted Rayleigh loops obtained in rocks. a, Totally constricted loop; b, Partially constricted loop.

the same is changed irreversibly by heat treatment. But in the case of rocks giving constricted Rayleigh loops, we have observed that the constriction disappears when they are subjected to fields of over 50 Oe A.C. or D.C. or when their temperature is raised or lowered with respect to the room temperature (24° C.) by a few tens of degrees. However, in all these cases the rocks regain their original condition after sometime and show exactly the same constricted loop as they did before they were subjected to the higher field or temperature changes. This recovery, displaying an extraordinary 'memory', is somewhat akin to

to a line in the centre may be termed "totally constricted loop" whereas that in Fig. 1 b may be called a "partially constricted loop". These constricted loops shown by the rocks are not due to an overall magnetic anisotropy, because all the loops remain the same for different orientations of the samples with respect to the direction of the magnetizing field. In these figures, as well as in those of 2, 3 and 4, one small division on the horizontal axis represents 0·5 Oe, and that on the vertical axis corresponds to 17×10^{-3} emu of magnetic moment.

The constricted loops have been observed for virgin specimens of fine and coarse-grained

basalts from lava flows and of dolerites from dykes. The Curie temperature of these rocks range from 200 to 500° C. and the magnetic mineral constituents are different titanomagnetites. In a few cases, the rocks showed constricted loops after they were heated to about 500° C. and cooled even though in their virgin state they yielded simple loops. This clearly indicates that at least in the case of some rocks the heat treatment alters their state so that they begin to show constricted loops.

TIME OF RECOVERY

The constriction in the Rayleigh loops shown by different rocks in fields of ± 10 Oe,

original state and showed constricted loops after sometime.

In Figs. 2 a and 2 b are shown the constricted and ordinary loops obtained for one of the specimens before and after subjecting it to a high field respectively. The main differences in the two loops are, firstly, the hysteresis loss is more after removing the constriction as shown by the larger area of the loop in Fig. 2 b, and secondly, the maximum intensity of the specimen is also greater in the latter case. In Figs. 2 c to 2 f are shown the loops observed for the same specimen after a lapse of 1, 7, 13 and 30 days respectively. It can be seen from
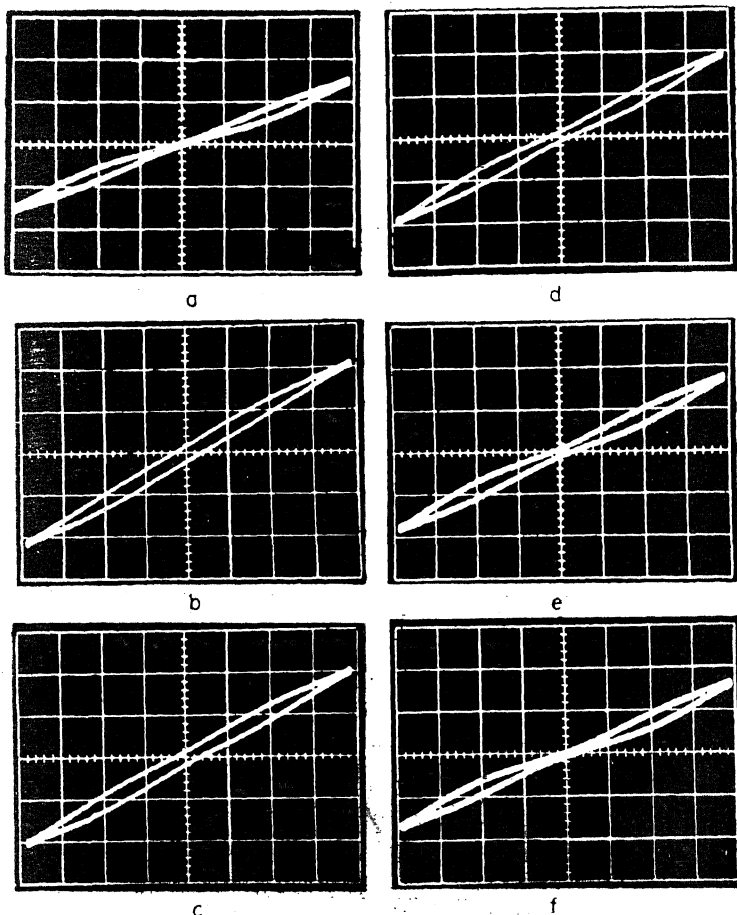
FIG. 2. Stages in the recovery of a constricted loop. *a*, Initial; *b*, After subjecting to 50 Oe; *c*, After 1 day; *d*, After 7 days; *e*, After 13 days; and *f*, After 30 days.

diminished gradually when the field was increased and disappeared in fields of about ± 50 Oe. After this the loops did not show constriction when the field was decreased back to 10 Oe. However, all the rocks regained their

these figures that the recovery of the initial state is some kind of an exponential process and that during the recovery there is a gradual increase in the amount of constriction accompanied by a fall in the maximum intensity

of the specimen until the initial state is fully regained.

The same phenomenon has been observed in the case of several rocks with recovery times ranging from a few days to about 4 weeks. Only for one rock specimen the recovery time was found to be 10 minutes, and in this case a definite tendency for recovery could be noticed just after one minute. This shows that even though the phenomenon is the same, different rocks require different times for recovery, the range observed so far being from a few minutes to a few weeks.

Further studies made on the specimen showing a 10-minute recovery time yielded following results :

1. The constriction in the loop of a specimen can be removed by subjecting it to fields of over 50 Oe A.C. or D.C. but the time of recovery is the same irrespective of the strength of the field used. This has been verified in D.C. fields of 50 to 10,000 Oe.

2. When after removing the constriction the specimen was kept in 10 Oe A.C. for observing the recovery, the loop did not show any tendency for recovery for a considerably long period. Normally the specimen showed a tendency for recovery in one minute when stored in earth's field (0·5 Oe), but in 10 Oe A.C. this tendency was not revealed even for 15 minutes which was more than the full recovery time, indicating that the recovery time of the specimen can be considerably enhanced by impressing an A.C. field on it.

TEMPERATURE DEPENDENCE

There is no provision in the apparatus at present for observing the hysteresis loop at different temperatures. However, the specimen can be heated or cooled to the desired temperature outside and quickly transferred to the specimen holder for studying its Rayleigh loop. In Figs. 3 *a*, 3 *b* and 3 *c* are shown the loops for a specimen at 0° C., room temperature (24° C.) and 100° C. respectively. It was found that the constriction in the loop disappeared when the temperature of the specimen was raised or lowered by about 20° C. with respect to the room temperature, but reappeared when the specimen was brought back to the room temperature. However, if the specimen was heated to a higher temperature (> 100° C.) then the specimen took its full recovery time to regain its initial state giving a constricted loop. It was observed that specimens with
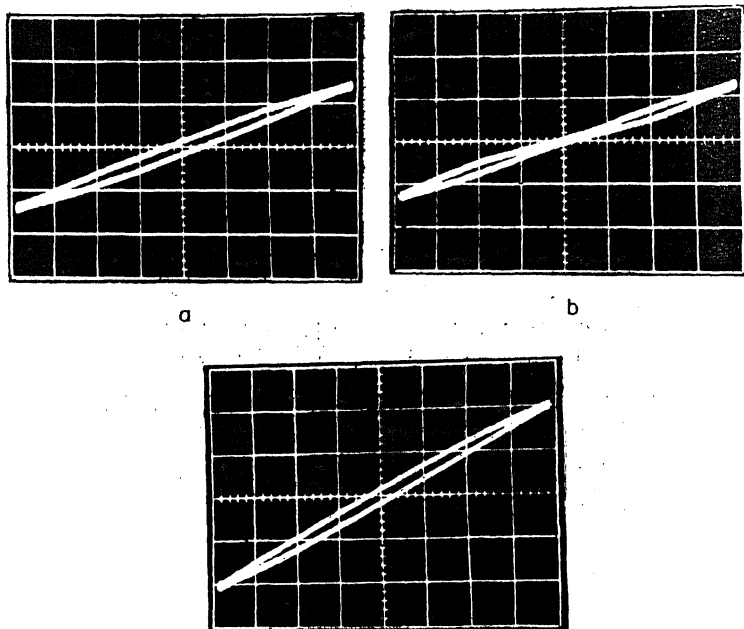
FIG. 3. Temperature dependence of the constricted loop of a rock. *a*, At 0° C. ; *b*, At 24° C. and *c*, At 100° C.

different recovery periods behave in a similar way.

DEPENDENCE ON MECHANICAL SHOCKS

It is rather interesting to note the delicate nature of the magnetic state of the rocks. The constriction in the Rayleigh loops of the rocks disappeared when they were subjected to mechanical shocks such as due to slight hammering. However, in these cases also the rocks regained their initial state giving constricted loops after their full recovery periods.

LINE AND LOOP PHENOMENON

The magnetic behaviour of rocks in a field of about 10 Oe A.C. varies widely. For some

straight lines initially, showed thick loops on subjecting them to high fields or slight heating or cooling. In such cases also, the rocks regained their initial state and gave tilted straight lines afer a lapse of time exhibiting a memory effect.

In Figs. 4 a and 4 b is shown the behaviour of a specimen before and after subjecting it to a field of 50 Oe. The intermediate stages of the recovery obtained after lapse of 1 and 3 days are shown in Figs. 4 c and 4 d respectively. After a lapse of one week the specimen showed a tilted line exactly like the one shown in Fig. 4 a. It was found that the recovery in the line–loop–line memory phenomenon often occurred through the intermediate stages consisting of constricted loops and/or irregular and
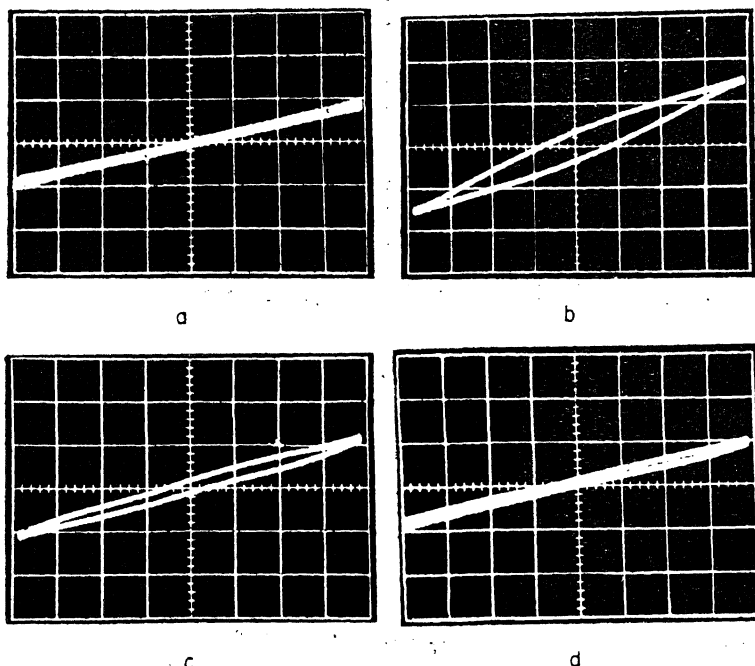
FIG. 4. Stages in the line–loop–line transition in the Rayleigh loop of a rock. *a*, Initial ; *b*. After subjecting to 50 Oe ; *c*, After 1 day ; and *d*, After 3 days.

rocks the susceptibility is almost constant whereas for others it varies over the range of the field. The former types give tilted straight lines whilst the latter ones show thin, thick or constricted loops in low fields. As mentioned in the previous sections, the rocks showing constricted loops display a memory effect. Many rocks that show thin or thick loops, or tilted straight lines, do not exhibit any change in their behaviour after subjecting them to high (> 50 Oe) fields or slight heating or cooling. However, some of the rocks which gave tilted

asymmetric loops. In such cases also the time of recovery was found to vary from a few minutes to a few weeks. In general the processes and the recovery periods are similar in the two types of memory effects described in the foregoing, except for the difference in the shapes of the initial loops. Also, the recovery in the line–loop–line transition is often *via* a constricted loop so that the stability of the initial constricted loop observed in some rocks itself becomes an interesting feature.

SUMMARY OF RESULTS

Two types of magnetic memory phenomena in low fields have been observed in rocks. The first one consists of a transition from a constricted loop to a thick loop on subjecting the rock to a high field and back to a constricted loop after a certain recovery time. This may be called the 'Constriction memory effect'. The second type involves line to elliptic loop and back to line transition with a fixed recovery period and this may be called the 'Line memory effect'. For both these transitions the physical processes occurring in the rocks are probably the same and similar to those discussed by Brissonneau[8] to account for the behaviour of the dilute solid solution of carbon in iron. He explains the variation of magnetization of iron with time due to reorientation of displaced Bloch walls from their initial equilibrium positions, through a process of diffusion. Considering the similarity of both the phenomena Neel[10] suggests that the same process of displacement and diffusion of Bloch walls may be the cause for the memory effects observed in rocks. However, it seems that these phenomena could also be caused by interacting single domain grains of varying sizes. A wide range of grain sizes is possible in volcanic rocks either due to rapid cooling or by slight alteration which may break down some of the original multidomain grains into smaller single domain grains, whose relaxation time is highly dependent on the size.[11] Thus, the presence of single domain grains of different relaxation times, in principle, can cause a variation of the magnetization of a rock containing them.

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INDIRECT POLAROGRAPHIC DETERMINATION OF STABILITY CONSTANTS

III. CDTA Complexes

R. SUNDARESAN, S. C. SARAIYA AND A. K. SUNDARAM

Analytical Division, Bhabha Atomic Research Centre, Trombay, Bombay-74

THE usefulness of the indirect polarographic method for the determination of stability constants of metal ion complexes even when they are not reducible or irreversibly reduced at the dropping mercury electrode is being investigated.[1,2] This paper reports the determination of stability constants of 1-2 diamino cyclohexane tetra acetic acid (CDTA) complexes of sodium and lithium using thallium as indicator ion.

EXPERIMENTAL

Current–potential curves were taken on a manual polarograph. All experiments were carried out in 0·1 M potassium nitrate at $30 \pm 0.5°$ C. A Cambridge Bench Type pH meter was used for pH measurements.

A standard solution of CDTA (M/s. Suhrid Geigy Ltd.) was prepared by the method of Pribil *et al.*[3] B. D. H. AnalaR samples of thallous sulphate, lithium nitrate and sodium nitrate were used for the preparation of standard solutions.

RESULTS AND DISCUSSION

A one-electron reversible wave with the half-wave potential at $- 0.4562$ V *vs.* S.C.E., was

obtained for thallium in 0·1 M potassium nitrate. Polarograms of 0·6 mM thallium solutions were taken in 0·1 M CDTA medium, pH being varied by the addition of potassium hydroxide. The half-wave potentials, determined from log-plots, at different pH are given in Table I.

TABLE I

Half-wave potentials of thallium in CDTA at different pH

Tl=0·6 mM;   CDTA=0·1M; KNO_3=0·1M;
Capillary—1

pH	$E_{\frac{1}{2}}$ — V vs. S.C.E.	i_d μA
7·72	0·5111	1·54
8·45	0·5306	1·41
8·77	0·5562	1·35
9·66	0·6122	1·26
10·94	0·6721	1·25
11·46	0·7036	1·25
13·50	0·7426	1·32

$-(E_{\frac{1}{2}})_s$=0·4562 V vs. S.C.E.; $(i_d)_s$=2·86 μA.

CDTA is present in solution as a mixture of H_4Y(Undiss), H_3Y^-, H_2Y^{-2}, HY^{-3} and Y^{-4}. The concentration of Y^{-4} can be calculated from the pH of the solution and the pK values of CDTA from the equation,

$$C_y = (Y^{-4})\, \theta \qquad (1)$$

where C_y is the total concentration of CDTA and

$$\theta = \frac{(H)^4}{K_1K_2K_3K_4} + \frac{(H)^3}{K_2K_3K_4}$$
$$+ \frac{(H)^2}{K_3K_4} + \frac{(H)}{K_4} + 1. \qquad (2)$$

The co-ordination number was calculated as one and the stability constant of thallium-CDTA complex as $10^{5.84}$ using the equation

$$-E\tfrac{1}{2} = 0·06 \log K_c \cdot \frac{(id)_s}{(id)_c} - 0·06 \cdot p \log (Y^{-4}) \qquad (3)$$

Sodium and Lithium-CDTA Complexes.—The half-wave potentials of thallium were measured in the presence of different concentrations of sodium (or lithium) nitrate and CDTA at pH above 13. CDTA exists as Y^{-4} at pH above 13, the pK_4 value being 11·70. The free ligand

concentration was calculated from a plot of the half-wave potentials of thallium vs. log (C_y/θ). The concentrations of free sodium ion and the complex could be calculated and the stability constant of the complex determined from

$$K_{NaY} = \frac{[NaY]}{[Na][Y]}, \qquad (4)$$

The stability constants of sodium and lithium complexes are given in Tables II and III. The log of the stability constants of the sodium-CDTA complex is 2·70 and that of lithium complex is 4·13.

TABLE II

Stability constants of sodium-CDTA complex

Tl=0·6 mM;   pH≃13;   Capillary—1;
Log K_{TlY}=5·84; $(i_d)_s$=2·86 μA;
$NaNO_3 + KNO_3$=0·1 M

$NaNO_3$ M	CDTA M	$E_{\frac{1}{2}}$ — V vs. S.C.E.	i_d μA	Log K_{NaY}
0·10	0·02	0·5887	1·30	2·68
0·10	0·03	0·6010	1·35	2·71
0·10	0·04	0·6113	1·29	2·73
0·04	0·02	0·6222	1·26	2·66
0·08	0·02	0·5973	1·34	2·66

TABLE III

Stability constants of Lithium-CDTA complex

Tl=0·6 mM;   pH≃13;   Capillary—2;   Log K_{TlY}=5·84;
$(i_d)_s$=2·80 μA

$LiNO_3$ M	KNO_3 M	CDTA M	$E_{\frac{1}{2}}$ — V vs. S.C.E.	i_d μA	Log K_{LiY}
0·10	0·1	0·02	0·509	1·60	4·04
0·10	0·1	0·04	0·529	1·50	4·13
0·04	0·1	0·02	0·539	1·43	4·14
0·10	..	0·02	0·510	1·60	4·03

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CONJUGATION OF *VIBRIO CHOLERAE* STRAINS ON MEMBRANE FILTERS

K. BHASKARAN, V. B. SINHA AND S. S. IYER

Central Drug Research Institute, Lucknow, India

AS in *Escherichia coli*[1] and *Salmonella typhimurium*,[2] conjugation in *Vibrio choleræ* is mediated by a fertility factor, designated as the P-factor.[3] This factor is itself transmitted from strain to strain by conjugation. Genetic recombinants can be isolated from crosses between P+ and P- strains.[4,5] It appeared that P+ strains functioned as gene donors while P- strains served as recipients.[5,6]

Because of their active motility, conjugation between *V. choleræ* cells is liable to frequent interruptions. In the case of F-factor mediated conjugation in *E. coli*[7] and transfer of R factors in enteric bacteria,[8] such interruptions were minimised and firmer cell-to-cell contact was achieved by fixing the parent cells on membrane filters, the pores of which restricted the bacteria while letting fluids to pass through. It seemed worthwhile to utilise this technique for studying conjugation in *V. choleræ*, and the results of the study carried out so far are summarised here.

In the experiments 5 ml. amounts of 3 hr. broth cultures of the mating strains were mixed and filtered through membrane filters ('Metricel', Gelman Instrument Co., Ann Arbor, Mich.; pore size 0·45 μ). The membranes were then incubated at 37° C. on the surface of nutrient agar plates, the sterile surface of the membrane being in contact with agar. The cells thus mated were resuspended in fluid minimal medium at intervals of time, and tests were carried out to score the frequency of transfer of P factor from P+ to P- cells. Experiments were also performed to determine the number of recombinants that can be isolated by plating these cultures on appropriate selective media. Pooled broth suspensions of the same strains, set aside without filtration through membrane, served as controls.

P+ and P- derivatives of *V. choleræ* strains, V 58 and V 63, isolated earlier, were used.[5] When mixtures of P+ and P- cells (2·5 × 10⁹ organisms of each) were incubated on membrane filters, transfer of P factor from V 58 P+ to V 63 P- and from V 63 P+ to V 58 P- occurred rapidly; 75–100% of the P- strain acquiring the P factor in 30–60 minutes. In nutrient broth controls, such a transfer was detected only in about 10% of the cells in 60 minutes. When cell suspensions recovered from the membranes after 30 minutes incubation were examined

under microscope, clumping of cells could be seen which was suggestive of efficient pairing. This was not so obvious in the controls.

Recombinants were isolated in greater numbers when the cells were plated on selective minimal media after pre-incubation on membrane filters than in controls (Table I).

TABLE I
Comparative frequency of recombinants pre-incubation on membrane filter and in nutrient broth

Cross		Selective markers		No. of recombinants (per 10⁸ cells of the pool)	
Strain V58	Strain V63	Strain V58	Strain V63	Membrane filter (1 hr.)	Nutrient broth (1 hr.)
P+	P-	leu+	ilv+ arg+ his+	63	14
		pur+ leu+	arg+	66	7
P-	P+	leu+	ilv+ arg+ his+	55	1
		pur+ leu+	arg+	18	8
P+	P+	leu+	ilv+ arg+ his+	9	3
		pur+ leu+	arg+	7	1
P- (Control)	P-	leu+	ilv+ arg+ his+	1*	nil
		pur+ leu+	arg+	nil	nil

Markers of V58 = str-s pur+ ilv⁻ O-Og arg⁻ leu+ his⁻
" V63 = str-r pur⁻ ilv⁻ O In arg+ leu⁻ his+
pur = purine; ilv = valine + i oleucine; arg = arginine; leu = leucine; his = histidine; O·Og = O antigenic type Ogawa; O-In = O antigen ic type Inaba; str-s = streptomycin-sensitive; str-r = resistant to streptomycin (500 μg /ml.) (+) indicates independence. (⁻) indicates dependence. * leu mutant of V63.

A study of the unselected markers of the recombinants thus isolated showed little evidence of unidirectional transfer of genetic material, as recombinants seemed to arise from both the strains employed in the cross. Because of the high frequency of transfer of P factor on membrane filter, it was possible that these recombinants resulted both from P+ × P- and P+ × P+ matings.

In order to investigate this, experiments were carried out as described in *E. coli*,[9] employing

a streptomycin-sensitive P+ and a streptomycin-resistant P- strain for such crosses and using selective media containing streptomycin (... μg. ml.) for the isolation of recombinants. On such media, only the P- strain can survive and be capable of giving rise to recombinants. Results of these experiments are given in Table II.

It will be seen that recombinants were isolated in large numbers only from P⁺ × P⁻ cross after pre-incubation on membrane filter. If the membrane filter technique was omitted,

as in controls, there was a considerable reduction in their numbers. Such a reduction was also seen in reversed P⁺ × P⁻ and P⁺ × P⁺ crosses. These findings provide strong evidence for one-way transfer of genetic material in *V. choleræ*, as is known in *E. coli*[9] and *S. typhimurium*.[10]

It is obvious that the membrane filter technique should permit detailed studies on the kinetics of the mating process in *V. choleræ* and also facilitate crosses between *V. choleræ* and *V. el Tor* strains and between *V. el Tor* strains which presented difficulties in the past.[11]

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A DENSE FRUITED MUTATION IN INDUCED AUTOTETRAPLOID BROWN SARSON (*BRASSICA CAMPESTRIS* var. BROWN SARSON)

D. SRINIVASACHAR

Division of Genetics, Indian Agricultural Research Institute, New Delhi-12

SEED yield in induced autotetraploid brown sarson, *Brassica campestris* var. brown sarson, could be increased not only by selecting plants for larger number of branches, larger number of seeds per siliqua and higher seed weight but also by selecting plants having a larger number of silique per branch. Such a "dense fruiting" mutation, arising as a result of radiation, is reported in this note.

Induced polyploids have been of economic value in only a few species principally those grown for their vegetative or floral parts. Autotetraploids of some crop plants have proved valuable because of their intrinsically superior qualities conferred by polyploidy alone. The ...ful of these is the cereal rye which ... successfully with diploids by virtue

of its large kernel size, superior sprouting ability and better baking quality of the grain due to its high protein content. (Muntzing).[5] It has, however, some disadvantages such as reduced tillering, lower seed setting, tall straw which makes harvesting with combines difficult and also the necessity of isolating it from the diploids with which it crosses readily resulting in sterile triploids. Similar advantages and disadvantages like low seed setting are also found in other induced autotetraploid cereals and oil crops. Some of these defects have been partly rectified.

Employing the mass pedigree method of breeding Parthasarathy and Rajan[6] considerably improved the fertility of tetraploid population of *Brassica campestris* var. *toria* which was

highly sterile when it was originally produced.[7] Asana *et al.*[1] made a comparative and comprehensive study of the morphological characters relating to yield, of autotetraploid 'elite A' produced by Parthasarathy and Rajan[6] and its original diploid progenitor. They found that the autotetraploid consistently produced less number of branches than the corresponding diploid. Consequently the diploid outyielded the tetraploid in spite of the latter having 50-55% higher seed weight. As the fruit number per branch did not differ much in the two chromosomal races they concluded that if the difference in branch number between the diploid and the autotetraploid was narrowed down by further selection, the autotetraploid could be expected to compete with the diploid. Instances are known where tetraploids are either inferior or only equal to diploids in respect of particular morphological characters. Thus, Kostoff and Kendall in tomato,[3] Deshmukh and Pal in Nicotiana[2] and others reported that induced tetraploids were either equal to or shorter than the corresponding diploids. Similarly, in *Sesamum* and *Linum* while some types responded to duplication of chromosomes with reduced branches others showed a larger number of branches and even branches of a higher order than present in the diploids.[8] Kuckuck and Levan[4] have also reported that different varieties of *Linum usitatissimum* react differently to duplication. It may also be possible to induce larger number of branches by mutation breeding.

While conducting some experiments in which seeds of *B. campestris* var. brown *sarson*, variety GBS 223, were irradiated with 60 kilo rads of gamma-rays first and immediately afterwards treated with 0.2% aqueous colchicine for 30 hours to duplicate their chromosomes, a tetraploid was isolated in the 1966-67 crop season. The progeny of this tetraploid, besides showing the usual gigas characters accompanying duplication of chromosomes, bore a large number of silique on the fruiting stalks (Fig. 1). The intersiliqual space in these plants was much reduced as the total length of the fruiting branch remained more or less the same as in the other colchicine induced tetraploids (Fig. 2). This mutant may have arisen as a result of the effect of radiation as no such variation was noticed either in colchicine induced tetraploid without previous irradiation or their segregating populations. Such a variation was also not met with among the diploid brown *sarson* varieties. The large number of

silique per branch in this mutant may compensate for the low branch number in the tetraploids since Stolle[9] observed a high positive correlation between number of pods and yield per plant in winter rape.
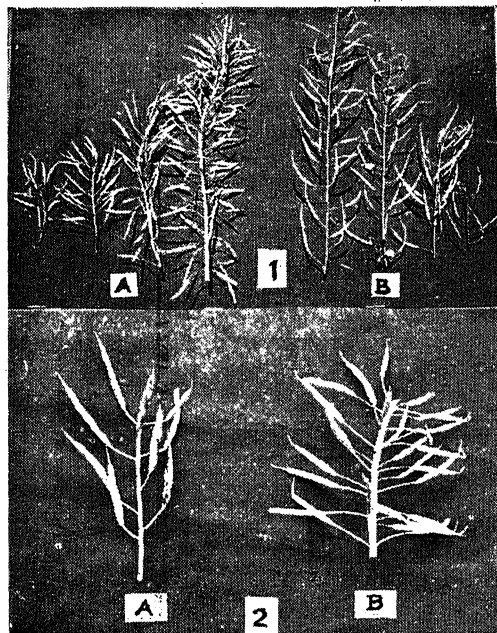
FIG. 1. A-B. Fig. A. Tertiary, secondary, primary branches and main shoot respectively of mutant tetraploid. Fig. B. Main shoot: primary, secondary and tertiary branches respectively of diploid.

FIG. 2. A-B. Fig. A. Fruiting branch of normal tetraploid. Fig. B. Fruiting branch of mutant tetraploid. Note the narrow intersiliqual space.

If all the important yield components, namely larger number of branches, higher seed weight, larger number of seeds per siliqua and larger number of silique per branch could be combined in a tetraploid the brown *sarson* may even become economically more important than the diploid.

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LETTERS TO THE EDITOR

EFFECT OF THE FINITE NUCLEAR SIZE ON THE X-RAY L_I-L_{II} LEVEL SEPARATION

It was shown in our earlier paper (Krishnan and Nigam, 1964) that the separation of the X-ray levels L_I and L_{II} could not be accounted for by calculating the energy levels with the help of the relativistic formula alone. On including the higher order relativistic terms the theoretical value of L_t-L_{II} showed deviations from the experimentally determined values using the frequency difference of the lines $L\beta_1(M_{IV}$-$L_{II})$ and $L\beta_{10}(M_{IV}$-$L_{II})$. On including the various field theoretical effects such as second order relativistic shift, second order magnetic moment, vacuum polarisation, Lamb shift, etc., the deviations reduced to a considerable degree. The results are indicated in Fig. 1 where R is the relativistic and E the experimental curve, and R + F is the curve obtained from R after including the field theory corrections.
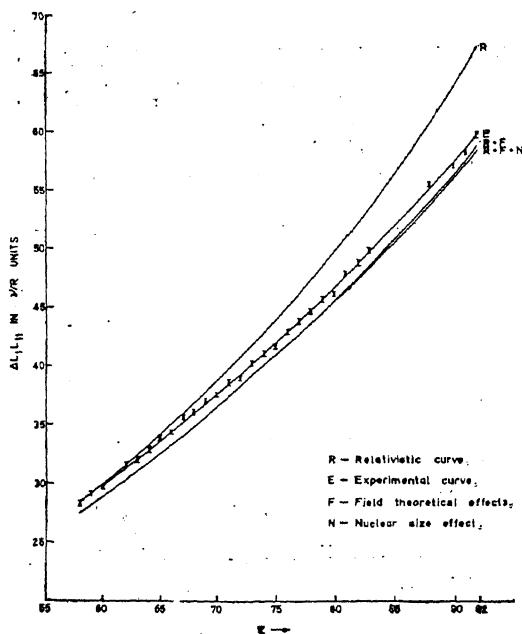
FIG. 1

On the suggestion of Prof. G. W. Series* we have now included the correction due to the

finite nuclear size as given by the formula (Novick et al., 1955):

$$\triangle = \frac{1}{24\pi}\frac{e^2}{a_0\hbar}\left(\frac{a_n}{a_0}\right)^2 Z^4 \text{ mega cycles} \qquad (1)$$

where a_0 is the first Bohr radius of the hydrogen atom, a_n is the nuclear radius, the rest of the symbols have their usual meanings. This formula has been derived from theoretical considerations and is therefore preferred over Schawlow and Townes' empirical estimate (Schawlow and Townes, 1952). Table I collects

TABLE I

Correction due to nuclear size

Z	Correction in $\nu/_R$ units	Z	Correction in $\nu/_R$ units
50	0·016	72	0·096
51	0·018	73	0·103
52	0·020	74	0·110
53	0·022	75	0·117
54	0·024	76	0·125
55	0·026	77	0·133
56	0·028	78	0·141
57	0·031	79	0·150
58	0·033	80	0·160
59	0·036	81	0·166
60	0·039	82	0·181
61	0·042	83	0·191
62	0·046	84	0·201
63	0·050	85	0·212
64	0·054	86	0·230
65	0·058	87	0·242
66	0·063	88	0·256
67	0·068	89	0·269
68	0·073	90	0·285
69	0·078	91	0·298
70	0·084	92	0·318
71	0·089		

the results of eqn. (1). The effect of the nuclear size is to shift both L_I and L_{II} levels towards lower binding energy side, the L_I level being an s-level shifts by a larger amount and the shift of L_{II} level which is a p-level is extremely small and can be neglected. Thus the total effect of the finite nuclear size can be looked upon as effectively reducing the original L_I-L_{II} value. Due to this reason the correction $\triangle$ has been subtracted in Fig. 1 from the R + F curve giving rise to the curve R + F + N; N stands for the nuclear size correction.

It may be mentioned that the experimental curve (E in Fig. 1) has been redrawn from the latest data available in Bearden's tables (Bearden,

1964). The errors involved are indicated by vertical lines. The experimental data need a further refinement before any meaning can be attached to the existing differences between the new theoretical curve $(R + F + N)$ and the experimental curve (E).

The authors are grateful to Prof. R. K. Asundi for his valuable suggestions and to Dr. N. A. Narasimham for the facilities provided.

Spectroscopy Division,   T. V. KRISHNAN.
Bhabha Atomic Research   AMAR NATH NIGAM.
        Centre,
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DIMER FORMATION IN ERYTHROSIN AND ROSE BENGALE

SODIUM Fluorescein and its derivatives—Eosin, Erythrosin and Rose Bengale—may exist in a solution as dianions, monoanions, neutral molecules and dimers, etc., the proportion of each variety depending upon the concentration of the dye. So it is expected that a change in the fluorescence and absorption spectra may take place with a change in the concentration of the dye. In the present investigation the fluorescence spectra in glycerin-water mixture (50–50% by volume) and the absorption spectra in aqueous solution have been recorded at various concentrations of Erythrosin and Rose Bengale and the effect of concentration has been studied. The fluorescence spectra of Erythrosin and Rose Bengale, excited by the mercury wavelength 5460 Å, were recorded with a Hilger's constant deviation spectrograph and the spectrum intensities obtained using a recording microphotometer.

Figures 1 and 2 are the microphotometer records of the fluorescence of Erythrosin and Rose Bengale respectively. The sharp lines at 5460 Å, 5769 Å, 5790 Å and 6232 Å, appearing in the microphotometer record, are the scattered mercury lines. The fluorescence spectrum intensity curves 1, 2 and 3 of Fig. 1 correspond respectively to the Erythrosin concentrations 8.0×10^{-6}, 2.0×10^{-5} and 7.0×10^{-5} g./c.c. and the fluorescence spectrum intensity curves 1 and 2 of Fig. 2 correspond respectively to the Rose

Bengale concentrations 2.0×10^{-5} and 6.0×10^{-5} g./c.c. In each case an increase in the half band-width is observed at the higher concentrations. It appears that the fluorescence spectrum 3 of Fig. 1 results from the superimposition of two intensity curves, one having its maximum in the same region as the intensity curve-1 for lower concentration at $\lambda \sim 5680$ Å and the other having its maximum at a longer wavelength at $\lambda \sim 6000$ Å. The same appears to be the case for the intensity curve 2 of Fig. 2, the peak for lower concentration is at $\lambda \sim 5760$ Å and another appearing at higher concentration at $\lambda \sim 6100$ Å.
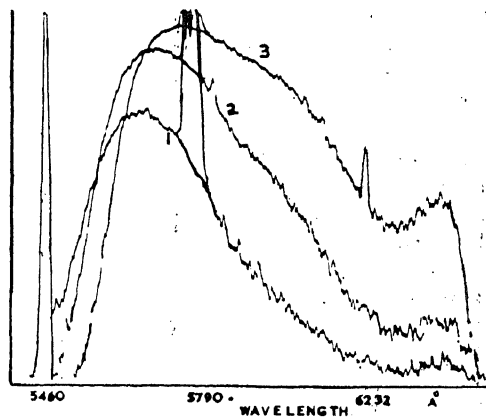
FIG. 1. Erythrosin ; Microphotometer records of the fluorescence spectra at concentrations—1 : 8.0×10^{-6} g./c.c. ; 2 : 2.0×10^{-5} g./c.c. ; 3 : 7.0×10^{-5} g./c.c.
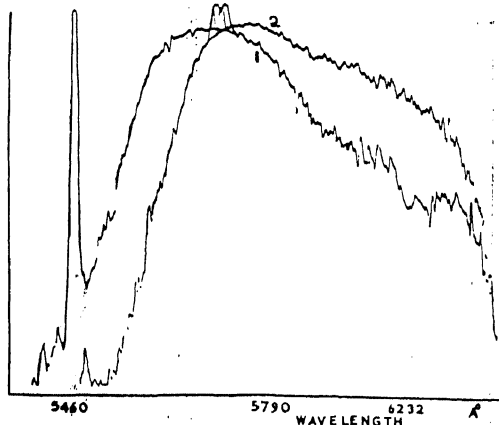
FIG. 2. Rose Bengale : Microphotometer records of the fluorescence spectra at concentrations—1 : 2.0×10^{-5} g./c.c. ; 2 : 6.0×10^{-5} g./c.c.

Figures 3 and 4 are the absorption spectra of Rose Bengale and Erythrosin respectively. Absorption curves 1, 2 and 3 of Fig. 4 correspond to the Erythrosin concentrations 1.25×10^{-5}, 2.50×10^{-5} and 5.0×10^{-5} g./c.c. respec-

tively, and the absorption curves 1, 2 and 3 of Fig. 3 correspond to the Rose Bengale concentrations 2.0×10^{-5}, 5.0×10^{-5} and 7.0×10^{-5} g./c.c. respectively. In each case at higher concentrations of the dye a new peak appears in addition to the peak which is present at lower concentration of the dye. In all the cases this
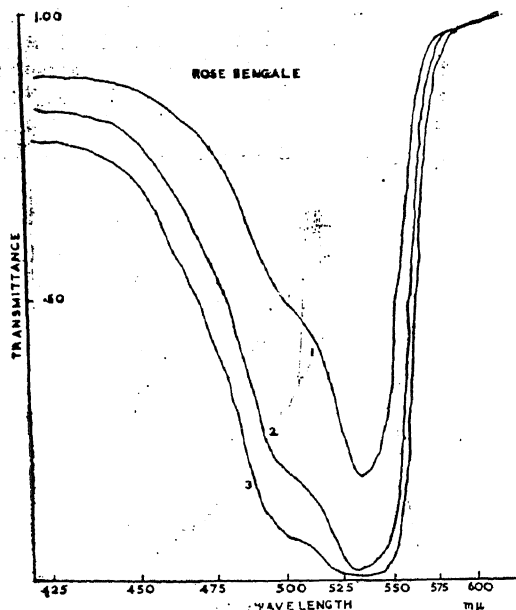
FIG. 3. Rose Bengale: Absorption spectra at concentrations—1: 2.0×10^{-5} g./c.c.; 2: 5.0×10^{-5} g./c.c.: and 3: 7.0×10^{-5} g./c.c.
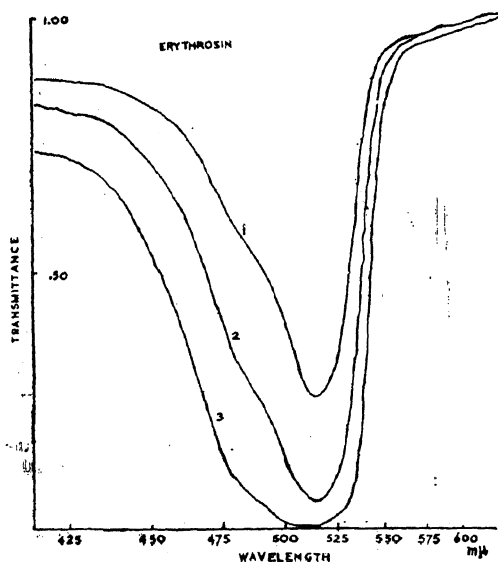
FIG. 4. Erythrosin: Absorption spectra at concentrations—1: 1.25×10^{-5} g./c.c.; 2: 2.50×10^{-5} g./c.c. and 3: 5.0×10^{-5} g./c.c.

additional peak at higher concentration lies on the shorter wavelength side. In Erythrosin the two peaks are at $\lambda \sim 5130$ Å and $\lambda \sim 4800$ Å and in Rose Bengale at $\lambda \sim 5320$ Å and $\lambda \sim 4970$ Å.

The fluorescence peak at $\lambda \sim 5680$ Å and the absorption peak at $\lambda \sim 5130$ Å, in case of Erythrosin, correspond to the dianions of Erythrosin as shown by their appearance at lower concentrations where the dye is known to exist in doubly ionised form.[1] Similarly the fluorescence peak at $\lambda \sim 5760$ Å and the absorption peak at $\lambda \sim 5320$ Å, in case of Rose Bengale, correspond to its dianions.[1] In case of Erythrosin the observed fluorescence peak at shorter wavelength $\lambda \sim 5680$ Å lies in the same region as the single peak reported by earlier workers[1] at $\lambda \sim 5600$ Å. The difference in location of the peak may be due to different solvents. But in case of Rose Bengale the fluorescence peak has been reported in [1] to be at 5900 Å which does not coincide with any of the peaks at $\lambda \sim 5760$ Å and $\lambda \sim 6100$ Å as observed by us. Probably, in [1] the fluorescence spectrum of Rose Bengale has been recorded at a higher concentration of the dye which will show a mean maximum in the reported region of [1]. The peaks at higher concentrations in the absorption and fluorescence spectra, in each case, seem to be due to some common cause as shown by their appearance at the concentrations of the same order and may be attributed to the dimers of these dyes which will be in greater abundance at higher concentrations.

Similar results have also been obtained by us for fluorescein and eosin indicating dimer formation in those cases.[2]

Dept. of Physics and   M. K. MACHWE.
    Astrophysics,   J. KISHORE.
University of Delhi,   K. GOPALAKRISHNAN.
Delhi-7, *April* 1, 1967.   S. S. RATHI.

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COMPLEXES OF NICKEL PERCHLORATE WITH γ-PICOLINE

EARLIER we reported[1] some four and six-co-ordinated paramagnetic nickel (II) complexes obtained by reacting nickel chloride, thiocyanate and perchlorate with 4–vinyl pyridine. In this communication, we report two more complexes obtained by reacting nickel perchlorate with γ-picoline. These compounds are interesting specially because we obtained both six-co-ordinated paramagnetic and tetra-co-ordinated

diamagnetic complexes using γ–picoline as a ligand whereas only the latter compound was reported[2] earlier.

Nickel perchlorate obtained by reacting excess nickel carbonate with perchloric acid was treated with an aliquot amount of the ligand. After shaking a light blue crystalline compound separated out which was filtered, washed with ether and dried *in vacuo* [Found : Ni, 7·0 ; $NiL_6(ClO_4)_2$ requires 7·19 ; and $NiL_4(ClO_4)_2$ requires 9·3%]. It changes colour from light blue to yellow at 95° C. which does not decompose upto 260° C. The compound is fairly soluble in acetone, alcohol and nitrobenzene. It is a 1 : 2 electrolyte in acetone medium, Λ_M being 252 mhos. The compound is paramagnetic in powder form indicating two unpaired spins ($\mu_{eff} = 3·24$ B.M. at 27° C.). When heated at 95° C. to constant weight, it undergoes thermal decomposition to a yellow compound. The observed percentage loss in weight was 26·5 against a calculated value of 22·8 for the loss of two moles of the ligand. This yellow compound on analysis corresponded to the composition $NiL_4(ClO_4)_2$ (Found : Ni, 9·0 ; Calcd. : Ni, 9·3%). It is diamagnetic in powder form ($\mu_{eff} = 0$ at 30° C.). It is also a 1 : 2 electrolyte and the compound is essentially similar to the one reported[2] earlier. The conversion of the paramagnetic light blue compound to the diamagnetic yellow variety took place even on keeping for a month showing that the dissociation of two ligand molecules takes place spontaneously but slowly which can be hastened on heating. Further we could not obtain this yellow compound by direct reaction whilst the earlier workers obtained the yellow compound directly presumably due to the different method they had followed. The yellow compound on treating with excess of the ligand in ether medium is once again converted to the blue form. The following inter-conversion has been definitely established.

$$Ni (ClO_4)_2 + 6\gamma\text{–pico} \rightarrow [Ni (\gamma\text{–pico})_6](ClO_4)_2$$
light blue paramagnetic

heating at 95° C.
$$\xrightarrow{\hspace{2cm}}$$
$$\xleftarrow{\hspace{2cm}}$$ $[Ni (\gamma\text{–pico})_4] (ClO_4)_2$
with excess of γ–pico. yellow diamagnetic
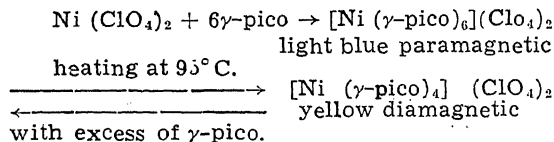
The I.R. spectrum in the region 5000–650 cm.[-1] was studied on Nujol mulls using Unicam SP 200 spectrophotometer. In addition to the modified (shifted and/or split) ligand absorption bands, strong and broad humps were observed at 1070–1140 cm.[-1] The ionic perchlorate absorbs[3] in the range 1050–1170 cm.[-1] and the broad bands obtained now are indicative of the presence of ionic perchlorate groups. The co-ordinated perchlorate shows[1] three distinct bands at 1155, 1080 and 1005 cm.[-1] which are not observed in the present case.

The blue, paramagnetic compound is a spin-free, octahedral complex of nickel (II), using $4 s 4 p^3 4 d^2$ hybrid orbitals for bonding. The underlying d^8 non-bonding shell is not symmetrical and hence causes perturbation to the above preferred stereochemistry. It appears that the repulsion exerted by the non–bonding electrons on the two axial bonds in the octahedral configuration is sufficiently large to remove the two ligands bonded in these positions so that a more stable tetra–co–ordinated compound is formed with necessary electronic rearrangement to give rise to a spin-paired diamagnetic planar configuration involving the use of $3 d 4 s 4 p^2$ hybrid orbitals.

Department of Chemistry, R. N. PATEL.
Regional Engineering D. V. RAMANA RAO.
College,
Rourkela-8 (India), *November* 14, 1966.

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HYDROGENATION OF 3-OXO-11 β (H)-EUDESM-4-EN-13 OIC ACID*

NOZOE *et al.*[1] have hydrogenated the racemic compound corresponding to structure (I) and transformed it to *cis*-decalin derivatives. This prompts us to publish our investigations which are at variance with the findings of the Japanese workers.

The (+) keto-acid (I) was previously converted to a keto-ester for which structure (II) is established.[2] Further support for the *trans*-ring junction in ester (II) is provided by its 60 Mc. NMR spectrum in carbon tetrachloride which exhibits a singlet for the angular methyl group at 8·92 τ comparable with that of the *trans*-decalone[3] (III) (8·95 τ). The ester (II) furnishes in 70% yield, the 2, 4-dinitrophenyl hydrazone, m.p. 153–54°, as orange needles (Found : C, 59·17; H, 6·25. $C_{22}H_{30}O_6N_4$ requires: C, 59·18; H, 6·77%).

Hydrogenation of the (+) keto-acid (I) at atmospheric pressure in ethanol in the presence of 10% palladium-charcoal followed by esterification of the resulting product with hot methanol and hydrochloric acid furnished the methyl ester which is composed almost exclusively of the *trans-ester* (II) on the basis of its IR and NMR spectra which are identical with those of the authentic sample. Further support is provided by the conversion of the methyl ester in 80% yield to the 2,4-dinitrophenyl-hydrazone of II (identified by m.p., mixed m.p. and IR spectrum). This transformation enables us to assign the stereochemistry of the hydrogenation product at C_5 (α-H), but not at C_4 which can undergo epimerisation under the experimental conditions employed.
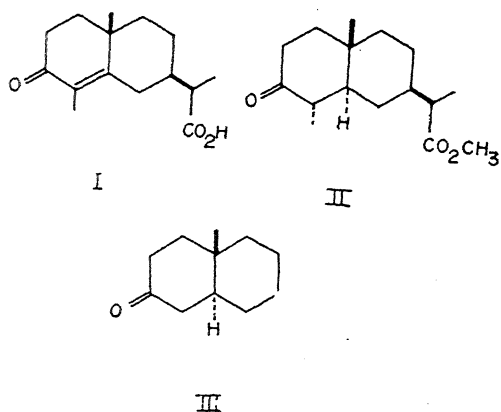
I

II

III

National Chemical Laboratory,   L. J. Patil.
Poona-8, *January* 16, 1967.   A. S. Rao.

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PSCHORR REACTION OF 2-AMINO-2'-FLUORO-N-METHYL BENZANILIDE

The Pschorr reaction of 2-amino-2'-substituted N-alkyl benzanilides of the type (A)
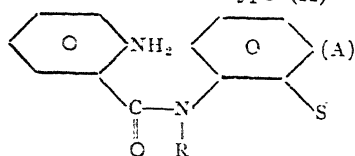
(Where S = Methyl, Nitro, Chloro, Ethyl, etc., and R = Methyl, Ethyl, Benzyl, etc.)

results in simultaneous deamination and dealkylation leading to 2'-substituted benzanilides[1] and not to the expected N-alkyl-1-substituted phenanthridones of the type (B).
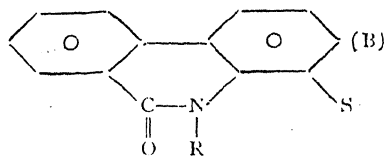
2-amino-N-methylbenzo-2'-napthalide exhibits similar deamination and dealkylation when subjected to Pschorr cyclisation.[2] These abnormal reactions, when a substituent is present *ortho* to the amido nitrogen, were attributed to the steric effect of the *ortho* substituent.[1] 2-amino-2'-methoxy-N-alkyl benzanilides on Pschorr reaction lead to a spirodienone through a new Dienone-Phenol rearrangement.[3]

To understand the effect of *ortho* fluoro substituent on the course of the reaction we carried out the Pschorr reaction on 2-amino-2'-fluoro-N-methyl benzanilide. The reaction product was a neutral brown gum (yield—54%), when worked up in the usual manner after the removal of phenolic impurities. Chromatographic separation of this material in benzene over alumina yielded a white crystalline compound. M.P. 170° C. (Yield—7–9%). $\lambda_{max.}$ 232, 259, 329 and 343 mμ. Log ϵ —4·55, 4·19, 3·86 and 3·80. The ultraviolet spectrum of this compound in ethanol, recorded in Beckman DU model shown in Fig. 1 is characteristic of an N-alkyl phenanthridone.[4]
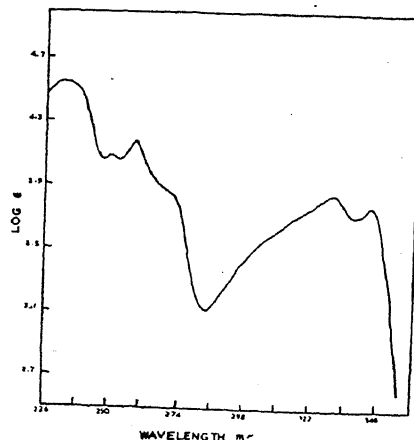
Fig. 1

The formation of N-methyl-1-fluoro phenanthridone shows that probably the steric effect of 2'-fluoro substituent, when compared to those of other necessarily larger groups, may not be

significant on the course of the Pschorr reaction. The chromatographic separation also yielded two more crystalline products one melting at 112° C., and the other, melting at 212° C. The ultraviolet spectrum of the last compound resembles that of symmetrical NN-dimethyl-NN-di-orthofluorophenyl diphenic acid diamide. No deaminated or deaminated and dealkylated product of the title compound could be isolated from the chromatographic separation. A full account of this and related work will be published elsewhere.

We thank Dr. K. Nagarajan of CIBA Research Centre, Bombay, for getting us O-fluoroaniline. Our thanks are also due to U.G.C. and Government of India for a fellowship and a scholarship to V.C.D. and V. K. respectively.

Department of Chemistry,   N. Arumugam.
Madurai University,   V. Kesavan.
Madurai (India),   V. C. Devanathan.
January 27, 1967.

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FORMATION AND STABILITY OF BERYLLIUM CATECHOLATE

The bivalent beryllium is known to form stable chelates with a number of ligands.[1-4] The present investigation gives an account of the formation and stability of beryllium catecholate.

Beryllium perchlorate and catechol (Johnson's recrystallized variety) were used. A poly-metron pH meter and Phillips Conductivity bridge were used, for the pH and conducto-metric measurements respectively.
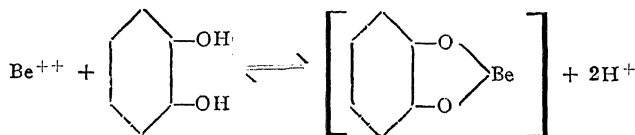
Addition of alkali to the reaction mixture neutralizes the H ions produced by chelation, the number of equivalents of alkali required being equal to the number of H^+ ions liberated. Potentiometric titration of M/30 beryllium perchlorate (10 c.c.) with varying amounts of M/30 catechol (10, 20 and 30 c.c.) against M/3 caustic soda solution also showed a sharp inflexion at $m = 2$ (m = equiv. alkali per mole of the metal ion) confirming the formation of monocatecholate complex.

In order to confirm further, potentiometric titrations of catechol alone and in presence of a small amount of beryllium ion were carried out with NaOH. At particular pH values the differences in the values of m indicate that $2 H^+$ ions per molecule of the monocatecholate are liberated. This proves that the formation is in equimolar ratios, $2 H^+$ ions being liberated from one mole of catechol.

Isolation of the solid compound.—To a mixture of strong solution of beryllium sulphate and catechol in equimolar proportion was added a drop of NaOH. The solution was refluxed and the black solid obtained was filtered. It was recrystallized, dried and the beryllium content estimated. The percentage of beryllium 7·5% fairly corresponds with the theoretical value of 7·9%.

The stability constant of the chelate was determined by Bjerrum's method. It works out to be $2·619 \times 10^{13}$ and hence the free energy change $\Delta F = - 18·30$ Kcals.

Chemical Laboratory,   E. Hanumanth Rao.
School of Studies in   P. K. Bhattacharya.
   Chemistry,
Vikram University,
Ujjain (M.P.), *November 25, 1966.*

Potentiometric and conductometric titration of beryllium perchlorate with catechol show a break at 1 : 1 ratio, indicating the formation of a monocatecholate. The chelation reaction can be represented as shown above.

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THE INFLUENCE OF THE SUBMANDIBULAR SALIVARY GLAND ON THE GONADS AND THE PARAGONADS

(PRELIMINARY COMMUNICATION)

THE influence of the submandibular salivary gland, so far regarded as a pure exocrine salivary gland, on growth has been demonstrated.[1] This shows the endocrinoid nature of the gland. In this preliminary communication experiments were done on 100 adult male Swiss albino mice and 6 monkeys. The animals were distributed in such a way, that excepting in the monkeys, the animals were litter-mates. In the experimental group the submandibular glands were bilaterally extirpated, by the same technique as reported earlier,[1] in the controls the ducts were bilaterally ligated at the hilum; in the absolute controls no operation was done at all. The animals were pair-fed (BJMC laboratories diet-102) and maintained under identical conditions. Examination of the gonads and the paragonads at the end of 50 days, revealed no changes in the duct-ligated and control animals. In those animals which had undergone bilateral submandibularectomy, there was a gross macroscopic atrophy of all the reproductive organs to half to one-third the size of the controls.

The microanatomy of the testis showed a marked degeneration of the seminiferous tubules, and a severe decrease in the columns of spermatogenesis, and a marked degree of oligospermia. A significant feature was the degeneration of the cells of Leydig. The epididymis showed a complete atrophy of the normal mucosa and a metaplasia at some places from ciliary epithelium to the squamous type, and complete absence of any sperms in the lumen. The seminal vesicles showed a complete atrophy of the papilliferous mucosa, with marked thinning of the walls, accompanied by cystic dilatation.

These interesting findings demonstrate the control of the submandibular salivary glands on the gonads. A similar phenomenon is seen in females.[2] Bilateral removal of the gonads, causes a decrease in the secretory tubules of the submandibular glands,[3] while administration of testosterone restores their morphology,[4] gonadectomy also causes a hyperchromatophilic change in the submandibular salivary gland.[5] Such an interrelation between the submandibular glands and the gonads shows the presence of a submandibularo-gonadal axis. Besides the gonads, it is the submandibular salivary gland

which shows a distinct sexual dimorphism histologically and biochemically.[6]

These findings, besides the action on growth, indicate positively to the endocrinal nature of the submandibular salivary gland with an internal secretion. These findings assume greater importance in the light of the fact that endocrine glands, like the anterior pituitary (which develops as the Rathke's pouch), and the thyroid gland develop as outgrowths, from the oro-pharyngeal mucosa, like the submandibular salivary gland. The thyroid in its development (with the thyroglossal duct) is also exocrinal, with a digestive function,[7] just like the submandibular gland. In fact phylogenetically and ontogenetically the primitive thyroid called the "endostyle" has both exocrine and endocrine functions.[8,9] These facts make the submandibular salivary gland akin to the primitive thyroid.

Its endocrine-like actions over the control of growth and the gonads, and its embryological similarity, with the endocrine glands, indicate that the submandibular salivary gland, besides its exocrine part, is also an endocrine gland.

Physiology Research   M. J. NARASIMHAN JR.
     Centre,   V. G. GANLA.
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STANDARDISATION OF SODIUM THIOSULPHATE BY TITRATION WITH DICHROMATE IN PRESENCE OF EDTA

THE usual method[1] for the standardisation of thiosulphate involves the titration of iodine liberated by the action of a known quantity of potassium dichromate on iodide by thiosulphate using starch as indicator. It is necessary in this procedure to keep the dichromate-hydriodic

acid mixture for about 15 minutes in the dark before titration so as to allow the reaction to go to completion and employ an acidity not more than 0.4 N. to avoid induced air oxidation of iodide. To accelerate this reaction Gaebler and Baty[2] have used oxalic acid which removes the freshly generated chromium (III) as an oxalate complex and thus shifts the potential of the chromium (VI)—chromium (III) couple to a more positive value. A method has been developed for the standardisation of thiosulphate by direct titration with potassium dichromate in presence of iodide and starch based on the favourable effect of oxalate on the dichromate hydriodic acid reaction.[3]

EDTA also is found to have a similar effect on dichromate–hydriodic acid reaction.[4] The authors have observed that accurate results for the standardisation of thiosulphate can be obtained by titrating a dichromate solution immediately after adding iodide and EDTA. The optimum conditions are 0.2 to 0.4 N. with respect to sulphuric or hydrochloric acid and 0.004 to 0.02 M. with respect to EDTA.

Alternatively, sodium thiosulphate solution can be standardised by titrating it with potassium dichromate as follows: To 10.00 ml. of about 0.05 N. sodium thiosulphate solution about 70 ml. of double distilled water, 10 ml. of 20% potassium iodide, 15 ml. of 0.2 M EDTA solution, 1 ml. of 1% starch solution are added. Finally, 6 ml. of 5 N. sulphuric or hydrochloric acid are added such that the overall acidity is 0.3 N. when the total volume is made up to 100 ml. It is then titrated with standard potassium dichromate solution. The colour change at the end-point is from pale violet to blue–violet. The violet colour is due to the chromium (III)—EDTA complex formed in the solution. The colour change at the end-point is quite sharp and reversible.

The acidity most favourable for the titration is 0.2 to 0.35 N. with respect to sulphuric or hydrochloric acid when the overall EDTA concentration is 0.03 M.

When the mineral acid concentration is 0.3 N., the optimum concentration of EDTA to give sharp and accurate end-points corresponding to the oxidation of thiosulphate to tetrathionate is found to be 0.02–0.04 M.

The titrations by either of the above methods give normalities agreeing to within 0.2% with the results obtained by Kolthoff's methods.[1,5]

The advantage of the present method is that at no stage free iodine exists in solution and thus no loss of it can occur and the titration can be done immediately after mixing the reagents.

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Andhra University,   B. V. S. Sarma.
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"KUNAVARAM SERIES"—ALKALINE GROUP OF ROCKS FROM INDIA

Though the presence of alkaline rocks in the Khammam District has been known for many years, very little attention has been paid to work out the details of the very interesting and complicated features of this clan. The recent work of Mahadevan *et al.*[1] and Krishnan[2] also did not bring out the details of this clan.

In 1960 the author investigated some features of the south-western portion of this alkaline belt which he later expanded to include the entire belt (Long. 81° 4′ and 81° 18′ 39″ and Lat. 17° 36′ 30′ and 17° 19′ 50″), eighteen miles long and two and a half miles wide; and this constitutes the largest belt in India.

The outstanding features of this alkaline clan, consisting of syenites and nepheline syenites, are gneissic banding, strong development of lineation, folded nature of the structure, occurrence of nepheline pegmatites with giant crystals of nepheline, corundum and zircon. Syenites are represented by pyrovene-, hornblende-, biotite-, sphene-, and quartz–bearing types and their pegmatitic phases. Nepheline syenites are comprised of basic members like biotite-melteigite and barkevikite-malignite (Subbarao).[3] The other members are pyroxene nepheline syenite and synodiorite, amphibole-, biotite-, sodalite-, cancrinite-, zircon-, and corundum-bearing nepheline syenites and their pegmatitic phases. Such a wide variety of rock types of a great extent with varied assemblage of minerals possessing uncommon textures like vermicular intergrowth between albite and sodalite that has been recognized for the first time in the nepheline syenites (Subbarao[4]) may conveniently be considered to form a series which the author

proposes to call by the name "Kunavaram Series" after the village Kunavaram, situated at the confluence of rivers Godavari and Sabari, along the banks of which occur the alkaline rocks as fringes. The "Kunavaram Series"— in its areal extent and geological setting compares well with the Oslo petrographic province described by Barth[5] and Tomkeriff.[6]

The detailed investigation of this alkaline clan has led the author to believe that they are plutonic igneous rocks which have been subsequently metamorphosed, still retaining their original igneous characters. Details will be published elsewhere.

The author thanks Prof. M. G. Chakrapani Naidu, Prof. A. F. Buddington, Princeton University (U.S.A.) and Dr. K. V. Suryanarayana for their critical reading of the manuscript.

Department of Geology,   K. V. Subbarao.
Sri Venkateswara Univ.,
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CHIRKI, A PALAEOLITHIC SITE ON THE PRAVARA RIVER IN THE UPPER GODAVARI BASIN IN INDIA

During earlier field work along the rivers Pravara, Mula and Upper Godavari a rich palaeolithic site on the right bank of the Pravara river, which is a tributary of the Upper Godavari, was discovered by the author. The site is rich in artefacts of a probably late Acheul handaxe complex and of a scraper-flake industry, which appear as surface finds. The tools are found in gullies and erosion rills, washed out from a 3-4 m thick deposit of gravels.

The tool-bearing deposit is a colluvio-alluvial gravel, which rests on a high rockbench on the right bank of the river. The major part of older alluvium at this place, however, is on the left bank of the river in the inner side of a meander. The whole tool-bearing deposit has been cut by numerous erosion gullies into a badland-topography.

The artefacts, which are eroded out of this deposit, belong to two different cultures which have been assigned so far to different ages in

the palaeolithic period. They belong to Series I and Series II as we call them in Indian terminology, or Early and Middle Stone Age.

The Series I artefacts consist of Late Acheul handaxes and cleavers (mostly of basalt), of hammerstones and of big flakes and scrapers of 4-6 inches lengthwise. The big scrapers-on-flake constitute a new phenomenon,' so far not described in India earlier. Another interesting new phenomenon is the small basalt flakes, which seem to be fashioning-flakes of handaxes. A number of these flakes seem to indicate that they have been used as tools, usually as scrapers. Small scrapers of basalt (of 1-3 inches) are entirely unknown in India.

The Series II artefacts (or Middle Stone Age) consist of a flake industry with Levallois influence, *i.e.*, of scrapers, borers, points and flakes of chalcedony, chert, jasper, heliotrope, moss agate, etc., in a size of 1-2 inches, rarely 3 inches. These tools, together with many flakes, core-fashioning chips and cores come out in hundreds from the deposit and lie on the surface of the gullies and mounds of the badlands.

A third industry, the so-called Series III, is found on the surface, but less abundant. It consists of blades and blade-flakes and cores of chalcedony (usually no other material is used for them). These tools are an indication of a distinct upper palaeolithic, pre-microlithic culture, which was supposed for a long time to be absent in India.

In this area the rock consists of two different types of basalt (Trap), belonging to two different flows. The weathering of the fine-grained basalt of the upper flow, which contains numerous veins and nodules of quartz and chalcedony (the source material for the Series II tools) is spheroidal and columnar. The spheroidal pebbles and prismatic blocks of the basalt gave the Stone Age Man a readily available material for his Series I implements. However, the majority of the Early Stone Age tools have been prepared from a very fine-grained, dark grey-coloured dolerite, with conchoidal fracture. This dyke material has not been successfully traced so far in the vicinity of the site.

A number of dykes, however, have been recently discovered by the author about 6 miles downstream near the confluence with the Godavari. The dykes run for about a half mile parallel to the river and form the steep right bank. They appear to be of the same rock type as that of the implements. The dykes are rather

far away and downstream from the site. The presence of some well-rounded dyke river pebbles makes it probable that similar dykes are to be found in the near upstream area. This seems to be even more probable, as in the chalcolthic mound of Nevasa (excavated by Sankalia in earlier years), 2 miles upstream from Chirki, a large number of big blocks of this material are found scattered in the mound debris. The blocks are too big and too numerous to have been transported from a long distance.

The probable availability of suitable raw material, the presence of cores and hammerstones and especially of core-flakes and tool-fashioning-flakes seem to indicate that we deal here with an occupation site or rather a factory site of Early Man.

The artefacts are all fresh and unrolled. Some of them, however, are quite weathered due to a long exposure to the elements. They are not transported by the river nor by the nallah. The site is one of the richest tool-bearing Early Stone Age site in the State of Maharashtra.

The question now arises about the age of the industries, about their correlation to each other and about their stratigraphic position. It is necessary to find out whether the artefacts are confined to distinct horizons, whether they belong to occupation floors or whether the tools are mixed and distributed throughout the deposit, in which case the deposit has been reworked in later times.

In order to answer these questions an excavation has been undertaken by the author since November 1966.

From the present evidence the site appears to be a factory site. Except for the tools of Early Stone Age the deposit would have been normally dated to Middle Stone Age. The occurrence of fresh unrolled Early Stone Age tools in this gravel has created a problem about the real antiquity of the Series I tools. It seems probable that the so-called Series I and Series II at this site are contemporaneous to each other and that they are two different expressions, two different tool types, of the same people of the same culture. This might come as a surprise to Indian researchers, as Nevasa was actually the first place in India where these tools were described by Sankalia as Series I and II.

It is proposed to undertake morphometric gravel analysis of the samples collected from the excavation site and of the samples from the modern river-bed and from the nallah bed for comparison.

Work at the site is in progress. Further excavations are proposed at Pimpalgaon, another recently discovered site about 4 miles downstream of Chirki, where a large number of Series I and II tools have come out from a stratified river gravel. The excavations will continue throughout the winter season.

Deccan College,   GUDRUN KARVE-CORVINUS.
Poona-6, *January* 27, 1967.

VARIABILITY FOR CAPSAICIN CONTENT IN CHILLI

CAPSAICIN, the alkaloid responsible for the pungency of chilli (*Capsicum annuum* L.) fruits, finds considerable use in the pharmaceutical and food industries. In a programme aimed at developing capsaicin-rich strains of chilli, a study of variability with regard to capsaicin-content of sun-dried fruits of some N.P. varieties of chilli was conducted, using ultra-violet absorption spectrometry after chromatographic partitioning of the alkaloid, as described by Deb *et al.*[1] As can be seen from the data in Table I, considerable variability in capsaicin content exists among the varieties studied, the range being from $0·2723$ to $1·1267$ mgm. per 100 mgm. of the powdered sun-dried fruits. The differences between the varieties were statistically highly significant ($p = 0·01$; C.D. at 1% — $0·578\%$). Heritability, in the broad sense, of capaicin-content worked out to about 93%; the differences between the varieties can, therefore, be attributed to genotypic differences.

TABLE I
Capsaicin-content (mgm./100 mgm.) in sun-dried fruits of twelve N.P. varieties of chilli

Variety	I	II	III	IV	Mean
N.P. 33	0·8271	0·7787	0·8078	0·7167	0·7826
N.P. 34	1·1367	1·1661	1·0806	1·1235	1·1267
N.P. 35	0·7200	0·7289	0·7844	0·6457	0·7198
N.P. 36	1·0616	1·0514	1·1560	1·0934	1·0906
N.P. 37	0·5391	0·5075	0·6944	0·7312	0·6181
N.P. 41	1·4299	1·5323	1·4462	1·5901	1·4979
N.P. 43	0·2400	0·2984	0·2569	0·2938	0·2723
N.P. 44	0·8744	0·8784	0·7888	0·8473	0·8472
N.P. 46	0·9535	0·8547	0·8441	0·9172	0·8924
N.P. 51	0·9085	0·9926	1·0746	1·1411	1·0292
N.P. 5-1-5	0·6180	0·6585	0·5920	0·5620	0·6076
N.P. 17-1-1	0·6233	0·8653	1·011	0·8830	0·8682

M.S.S. due to replications: $1·219$ (n.s.); M.S.S. due to varieties $56·80$ (sig. at 1%); C.D. at 1%: $0·1578\%$.

Earlier workers[2,3] suggested that pungency was monogenically dominant over non-pungency.

However, even where intermediate degrees of pungency were recognised, the organoleptic methods used did not permit of a quantitative approach as has been adopted in the present study. The results reported here would appear to suggest that capsaicin content should be considered to exhibit a continuous rather than a discrete variation implicit in monogenic control and in the classification into pungent and non-pungent classes adopted by earlier workers. Intuitively also, a continuous variation would appear to be more reasonable since variability might be expected in respect of capsaicin-secreting tissue as well as in respect of the efficiency of such tissue in secreting capsaicin. This would have considerable importance in breeding for high capsaicin content.

Thanks are due to Dr. A. B. Joshi, formerly Head of the Division of Botany and Shri S. Ramanujam, Geneticist, both at I.A.R.I. for their interest and guidance and to Dr. R. W. Cummings of the Rockefeller Foundation, New Delhi, for kindly making available a sample of pure capsaicin for this study.

Division of Botany,   D. K. Thirumalachar.*
Indian Agricultural
     Research Institute,
New Delhi-12, *November 19, 1966.*

* Present Address: Division of Botany, College of Agriculture, University of Agricultural Sciences, Bangalore 24.

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OIL CONTENT OF GROUNDNUT SEEDS

SINCE the causes of variation in oil content of oilseeds are not yet fully established, the present work was designed to find out the effect of seed size and the position of the seed within the pod on oilseeds are not yet fully established, the present *hypogœa* L.). The varieties used varied in seed weight but had two seeds per pod. The seed, within the shell, adjacent to the attachment of the pod to the gynophore is described as basal and the other as apical.[1]

The estimation of oil was carried out using 100 groups of seeds, each consisting of 20 basal and apical seeds, of four varieties grown under Sudan conditions during 1964/65. There was a negative correlation ($r = -0.862$) between oil percentage and seed weight (Table I). The weight per 20 seeds of varieties varied from 6.941 to 13.863 gm., whereas the oil percentage varied from 52.15 to 48.47% respectively. A similar relationship was found by El Saeed[2] and Pawlowski[3] in safflower seeds, though the two crops are markedly different in their seed characters.

Basal seeds were found to be more dormant than the apical ones, thus confirming earlier work.[4] Information about further differences in oil content and weight between these two types of seeds is lacking.[1] The current results suggest that the difference in weight between the two seeds, in all varieties, is too small to be of any practical significance. There is a suggestion, however, that oil percentage of basal seeds is greater than that of apical seeds in three out of the four varieties. Whether this is due to the differential maturity of the two types of seeds or perhaps due to the favourable position of the basal seed with regard to the supply of minerals and substrates

TABLE I

Weight and oil percentage of groundnut seeds

Variety		Oil %	Weight (gm.) of 20 seeds	Oil %		Weight (gm.) of 10 seeds	
				Basal seeds	Apical seeds	Basal seeds	Apical seeds
Rubatab	..	48.47	13.863	48.81	48.20	7.058	6.805
Ashford	..	49.58	10.246	50.65	48.39	5.304	4.942
Natal	..	50.37	7.901	49.61	51.16	3.890	4.011
Barberton	..	52.15	6.941	52.54	51.76	3.413	3.528
S.E. ±	..	0.420	0.130	0.594		0.184	
L.S.D. 05	..	1.233	0.383	1.747		0.543	
L.S.D. 01	..	1.679	0.521	2.378		0.739	

remain to be seen from further detailed investigation.

Dept. of Agronomy,   E. A. K. EL SAEED.
Faculty of Agriculture,
University of Khartoum,
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CORRELATION BETWEEN METHODS OF AVAILABLE NITROGEN WITH CROP RESPONSES

THE rate of change of organic nitrogen is the major soil characteristic that correlates with the capacity of soil to supply nitrogen to crops. The incubation method proposed by Stanford and Hanway (1955)[3] showed good correlation with crop responses in arable soils, but in paddy soils nitrification could be hardly an index of the availability of nitrogen. Attempts were made to characterise the nature and decomposability of organic nitrogen by using alkaline potassium permanganate as the reagent.

For the purposes of evaluating the fertility status and predicting crop responses to fertilizers, the per cent responses due to the application of particular nutrient is taken as the measure of availability of that nutrient in the soil. So, in order that the soil test may be of any value it becomes essential to correlate and calibrate the soil test method values with per cent responses in green-house and field experiments.

With this object in view, three different methods: (i) Alkaline potassium permanganate[4]; (ii) Rapid Iowa nitrification[3]; (iii) Richardson's modification of Olsen's method[2] were tried in the laboratory and the values were correlated with per cent responses, obtained in green-house and field experiments due to application of nitrogen. The bulk soil samples were brought from different agronomic centres and the green-house experiments were conducted at I.A.R.I., New Delhi. For field experiments the soil samples from the control plots for analysis and the yield data were obtained from the various centres where agronomic trials in the cultivators' fields were conducted on a country-wide soil fertility programme by I.C.A.R., and State Departments of Agriculture. They presented a wide variety of soils and climates. Their pH, calcium carbonate content, available nitrogen, available phosphorus and available potassium also varied widely. The texture of soils was from sandy loam to clay.

The data showed that the alkaline potassium permanganate method was the best of the three methods tried both in green-house and field experiments in paddy, wheat and bajra, giving significant correlations with per cent responses in all the soils except in red and yellow soils of Ajmer.

The incubation method gave comparatively lower correlation coefficients both in green-house and in the fields. The results were significant only in alluvial soils of Delhi. The Olsen's method did not give significant correlation with per cent responses in any of the soils.

It is also observed that the coefficient of correlation in the green-house were definitely higher than those obtained in the fields. This might possibly be due to many uncontrollable factors such as climatic conditions, soil properties, crop varieties, thickness of stand, cultural practices, insects and diseases—that affect the crop growth in the field. Most of the variable factors can more readily be controlled in green-house experiments than in field studies, which is evident from the results.

Division of Soil Science and   J. C. BAJAJ.
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Indian Agricultural
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A NEW RECORD OF PLANT FROM CALCUTTA—HOWRAH AREA

WHILE resurveying the weed flora of the Indian Botanic Garden, Sibpore, Howrah, the writers have noticed *Evolvulus alsinoides* Linn., a small diffuse perennial herb of *Convolvulaceæ*, growing about the sand stacked near the Central National Herbarium, located inside the Garden. It appears that the seeds of this species were intermixed with sands brought to the Garden for construction work and other purposes. The species has so far been recorded in the dry grassy places of Hooghly District (Prain, 1905) and in all western provinces, but rather rare in Central Bengal (Prain, 1903). There is no mention of the species in Mazumder's (1962)

The authors thank Prof. I. M. Rao for encouragement.

Department of Botany,   V. S. R. Das.
S.V. University,   M. S. Reddy.
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CERCOSPORIDIUM HELLERI ON SPHENOCLEA ZEYLANICA—A NEW RECORD FOR INDIA*

Sphenoclea zeylanica Gærtn. (Campanulaceæ) is an erect glabrous marsh herb, growing mostly in paddy fields. A severe leaf disease was observed by the author in the paddy fields adjacent to Paraparambu Road, Ernakulam, in October 1963.

The fungus was observed on the lower surface of the leaf as a velvety coating involving considerable areas, ultimately discolouring the leaves. The affected leaves present a crinkled appearance and fall off. A short description of the fungus is given below :
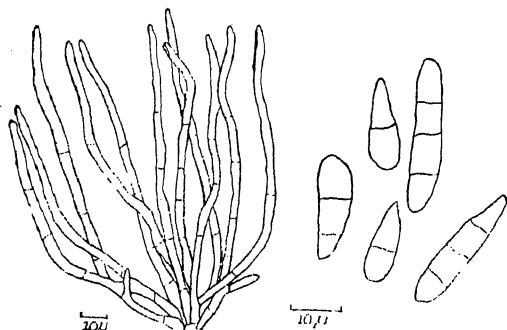
Foliicolous, hypophyllous, effused, forming a black velvety coating over larger areas, finally discolouring the leaves, but without any definite spots. Sporophores greatly elongated, branched, mostly curved, fasciculate, dark olivaceous, with a subhyaline and rounded tip, forming a tangled felted coating, the free distal end frequently twisted and flexed, scarred by the fallen conidia $55 \cdot 80{-}148 \cdot 80 \times 3 \cdot 77{-}5 \cdot 58 \mu$ with 2-5 septa. Conidia acrogenous and pleurogenous, obovate, obtuse, a few pyriform, granular, $26 \times 6 \cdot 5$ $(18 \cdot 6{-}33 \cdot 48 \times 5 \cdot 58{-}7 \cdot 44) \mu$ with 1-3 septa.

On living leaves of *Sphenoclea zeylanica* Gærtn. October 1963. Ernakulam (Kerala) K. M. Ponnappa. IMI 103593.

The genus *Cercosporidium* (Dematiaceæ) was established by Earle[1] with *Cercosporidium helleri* as type species. The fungus under study is identical with the one described by Earle in 1901. It has world-wide distribution on *Sphenoclea zeylanica* (F. C. Deighton, in litt.). However, a careful review of previous work showed that there was no record of this disease and the fungus causing it from India and is reported here as a new record for India.

Commonwealth Institute of   K. M. Ponnappa.
  Biological Control,
Indian Station,
Bangalore-6 (India), *November* 3, 1966.

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A NOTE ON THE RECORD OF RASTRELLIGER (MACKEREL) LARVAE FROM THE INDIAN OCEAN*

The preliminary analysis of the fish larvæ fraction of plankton samples, collected during the International Indian Ocean Expedition and retained in the International Collection at the Indian Ocean Biological Centre, has led to the notice of three early larval stages which have been identified as larvæ of the mackerel *Rastrelliger*. Special attention to a study of this group of larvæ was paid at the suggestion of Dr. N. K. Panikkar, Director, National

Institute of Oceanography, using the un-
published work of Mr. T. Matsui of the Scripps
Institution of Oceanography.

The specimens were collected using the Indian
Ocean Standard Net, hauled vertically from
200 m. to the surface. All three records are
from night-time collections. Station data
regarding collections are as follows:

TABLE I

Vessel and station	Length of specimen (mm.)	Latitude	Longitude	Date	Time (Local)
Anton Bruun, Cr. 4, Sta. 194	2·7	22°22′ N	60°05′ E	5–11–1963	0450
	3·1	16°37′ N	41°09′ E	7–12–1964	2145
Meteor, Sta. 73					
Pioneer, Sta. 16	5·3	18°15′ N	87°48′ E	8—5–1964	2000

FIGS. 1–3. Fig. 1. 2·7 mm. larva, from the northern part
of the Arabian Sea. Fig. 2. 3·1 mm. larva, from the Red
Sea. Fig 3. 5·3 mm. larva from the Bay of Bengal.

The above stages closely agree with descriptions
of *Rastrelliger* larvæ, probably *R. brachysoma*,
from the Gulf of Thailand and South China
Sea (Matsui, 1963). They resemble larvæ of
a scombrid relative, the Pacific mackerel
Pneumatophorous diego, described by Kramer
(1960), but differ in having less pigmentation
and a deeper body. The present series of larvæ
have a fairly stubby body, with 30 myomeres, big
eyes, wide mouth, coiled intestine, and a large
head devoid of opercular spines (Figs. 1-3).

It is hoped that during the continuing pro-
cessing of the fish larvæ in the samples of the
International Collection, further stages will
supplement the present series, which would
enable the specific identity of the specimens
to be determined.

Indian Ocean Biological Centre,   K. J. PETER.
National Institute of Oceanography,
Ernakulam-6, *April 26*, 1967.

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REVIEWS AND NOTICES OF BOOKS

Vector Spaces (Vol. I). By Prof. John Horvath. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London, W. 1), 1966. Pp: xii + 449. Price $ 12.75.

This book is an elementary introduction to topological vector spaces and their most important application : the theory of distributions of Laurent Schwartz. The text is intended for use in junior-senior-graduate courses in linear topological spaces and distributions, and as a supplement in courses in partial differential equations. Prerequisites include advanced calculus and a minimum of abstract algebra, metric space topology, and complex function theory.

There is a very detailed discussion, not existing elsewhere in the literature, of the spaces used in the theory of distributions. Proofs are equally detailed, as is all background material from topology and algebra, which is given in small print. The theory of distributions precedes that of integration and is given simultaneously with the theory of Radon measures, thereby clarifying which parts of the theory depend upon Lebesgue integration.

C. V. R.

High Energy Physics. By C. DeWitt and M. Jacob. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1965. Pp. xi + 509: Price : Paper $ 8.50 ; Cloth $ 10.50.

This book contains the lectures delivered at Les Houches during the 1965 session of the Summer School of Theoretical Physics, University of Grenoble. The first chapter begins with geometric invariance properties, illustrated by several examples, and concludes with a discussion of internal symmetries. Recent attempts have been made to connect internal and space time symmetries. This is the object of the second chapter which deals with SU_6. The third chapter gives a detailed account of the current mathematical techniques employed in treating strong interactions. Analyticity properties of scattering amplitudes are studied in detail within the framework of potential scattering theory and with the aid of simple graphs. This chapter contains also a treatment of Lorentz-invariance and a study of particles of arbitrary spin. It ends with an introduction to the three body problem. In the fourth chapter, the analyticity properties previously studied in the framework of specific models are generalized and serve as basis for an S-matrix theory of strong interactions. The fifth chapter exhibits the interpretation, in terms of a unitary symmetry model, of the properties of most of the known particles. The first part of the sixth chapter introduces general methods for determining the quantum numbers of the rapidly increasing number of newly discovered partices. The latter part of this chapter deals with the peripheral model for quasi two-body reactions. Recent developments in the theory of weak interactions are presented in the last chapter, including, in particular, a detailed study of the invariance properties in the decay of neutral K mesons.

This book is primarily for high energy physicists. It should provide for both experimentalists and theorists a view of most of the questions of current interest. C. V. R.

Prehistory and Earth Models. By Melvin A. Cook. (Max Parrish and Co. Ltd., 1-5, Portpool Lane, London E.C.I.), 1966. Pp. xiv + 353. Price 45 sh. Net.

If the earth is billions of years old, the volume under notice argues that all but the last few thousand years of scientifically readable prehistory has been erased perhaps by world-shaping catastrophes. The observed unbalance of radiocarbon, the abundance and influx of uranium in the oceans and helium in the atmosphere and systematic discrepancies in the radioactive 'time clocks' are among the substantiating arguments.

'Continental drift' is described as a recent catastrophic rupture of 'Pangaea' and sudden shift of its fragments (continents) under the tremendous forces of polar ice-caps. Crustal uplifts and depressions, shield geosynclinewelt interrelationships, the nature and occurrence of coal, oil and fossils, overthrusting and stacking of strata, for instance, in the Canadian Rockies, and other geologic information substantiate this novel reconstruction of prehistory.

Biological prehistory is discussed from the time implication and a central argument that spontaneous generation and 'organic' evolution go counter to 'times' arrow. Physics-chemistry,

differentiation. adaptation and mutations *vs.* speciation and anomalous fossilization are among the topics considered. Since 'life feeds on negative entropy' it is implied that life is an amazing, unnatural, intricately engineered phenomenon.   C. V. R.

Fundamentals of Radiobiology. (Completely Revised Second Edition.) By Z. M. Bacq and Peter Alexander. (The English Language Book Society and Pergamon Press, Headington Hill Hall. Oxford), 1966. Pp. xii + 562. Price 24 *sh.*

The scope of this book is indicated by the titles of the chapters contained therein, *viz.,* 1. Interaction of Ionizing Radiations with Matter : 2. Direct and Indirect Action in Biological System : 3. Dose-Response Relationships in Chemical and Biological Systems ; 4. The Nature of the Initial Chemical Lesion in Cellular Radiobiology ; 5. General Radiation Chemistry ; 6. The Radiation Chemistry of Aqueous Systems ; 7. Effect of Radiation on Macromolecules ; 8. Chemical Substances which Stimulate the Biological Effects of Ionizing Radiations ; 9. Effects at the Cellular Level ; 10. Biochemical Mechanism for Cellular Effects—The Enzyme Release Hypothesis ; 11. The Effect of Oxygen in Radiobiology ; 12. Comparative Radiosensitivity of Living Organisms ; 13. Pathological Biochemistry of Irradiated Living Organisms ; 14. Processes of Restoration after Irradiation ; 15. Neuro-Endocrine Reactions in Radiation Sickness : 16. Physiopathology of Radiation Sickness in Mammals ; 17. Delayed Effects ; 18. Interation between Cells and Tissues following Irradiation ; 19. Chemical Protection against X- and Gamma-Rays ; 20. Treatment by Bone-Marrow and Spleen Cells ; and 21. Human Experience.   C. V. R.

Annual Review of Biochemistry (Vol. 35, Part I). Edited by Paul D. Boyer. (Annual Reviews. Inc., 231 Grant Avenue, Palo Alto, California. U.S.A.), 1966. Pp. viii + 456 + Author Index pp. 91. Price $ 8.50 per copy (U.S.A.) and $ 9.00 (elsewhere).

Annual Review of Biochemistry (Vol. 35, Part II). Edited by Paul D. Boyer. (Annual Reviews. Inc., 231, Grant Avenue, Palo Alto, California. U.S.A.), 1966: Pp. iii + 457 to 908 — Author Index pp. 91. Price $ 8.50 per copy (U.S.A.) and $ 9.00 (elsewhere).

Volume 35, Parts I and II, contains the following articles : The Road to Cambridge, A. C. Chibnall : Mechanisms of Enzyme Action,

Irwin A. Rose ; Macromolecular Organization Enzyme Systems, Lester J. Reed and D. J. Cox ; Regulation of Enzyme Activity, D. E. Atkinson ; Dehydrogenases and Flavoprotein, Philipp Strittmatter ; Phosphoglycerides Phospholipases, L.L.M. van Deenen and G. H. Haas ; Messenger RNA : An Evaluation, Max F. Singer and Philip Leder ; Amino-Acid Metabolism, Harry P. Broquist and Joel Trupin ; The Methylation of Nucleic Acid Ernest Borek and P. R. Srinivasan ; Biochemistry of Viruses, H. G. Wittmann and C. Scholtissek Some Biochemical Aspects of Malignancy Henry C. Pitot ; Biochemistry of the Nitrogen Containing Hormones, Ira Pastan ; Vitamin B and Related Compounds, Fritz Wagner ; Application of Rapid Reaction Techniques to the Study of Biological Oxidations, Quentin H. Gibson Biochemistry of Bacterial Cell Walls, Hans H. Martin ; Polysaccharides, Nathan Sharon Carbohydrate Metabolism, M. A. Wood ; Lipid Metabolism, James Allen Olson ; Physical and Chemical Studies on Proteins and Polypeptides, William F. Harrington, Robert Josephs and David M. Segal ; The Chemistry of Peptides and Proteins, T. Wieland and H. Determann; Contractile Proteins, J. Gergely ; Protein Synthesis, Richard Schweet and Roger Heintz; Nucleic Acids—Sequence Analysis, U. L. Raj Bhandary and A. Stuart ; Physical Properties of Deoxyribonucleic Acid, John Josse and Joseph Eigner ; Immunoglobulins, Julian B. Fleischman ; and Water-Insoluble Derivatives of Enzymes, Antigens and Antibodies, Israel H. Silman and Ephraim Katchalski.   C. V. R.

Abstract Analysis. By Professor Andrew M. Gleason. (Addison Wesley Publishing Company, Inc., 10–15, Chitty Street, London, W. 1), 1966. Pp. xi + 404: Price $ 13.75.

This text is designed for use in the first course in real variable theory at the advanced undergraduate-graduate level. An important feature of this book is the explicit formulation of the set-theoretic approach to abstract mathematics. Although the foundations are not given axiomatically, the book is entirely consistent with the Hilbert-Bernays-Godel treatment of set theory. The axiom of choice and the ideas behind axiomatic set theory are explained in conjunction with the theory of cardinals. The book is designed for students having some experience with rigorous mathematics, as taught in advanced calculus, for example.   C. V. R.

The Particle Kinetics of Plasmas. By Professor I. P. Shkarofsky. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. x + 518. Price $ 17.50.

The book presents the fundamental ideas of particle kinetics which describe a gaseous plasma and applies these ideas in developing basic equations for plasmas under various conditions. Although only the behavior of gaseous plasmas is discussed explicitly in this book, some of the concepts are equally applicable to plasmas in the liquid or solid state. This volume is intended both as a reference book for the research worker and as a text in a course on plasma kinetics at the graduate level. Where possible, the subject matter is developed from first principles in sufficient detail to enable the reader to follow the derivation closely. A knowledge of vector and matrix calculus, differential equations, atomic physics, and electro-magnetism is assumed.   C. V. R.

Atom and Organism—*A New Approach to Theoretical Biology.* By Walter M. Elsasser. (Princeton University Press, Princeton, New Jersey, U.S.A.), 1966. Pp. viii + 143. Price 36 *sh.* net (in U.K. only); $ 4.50.

In this book a well-known physicist and geophysicist summarizes his stimulating ideas on the nature of the life process, which he presents in a novel and intriguing form.

Professor Elsasser, who is by training a theoretical physicist, has made many signal contributions to geophysics, among which his theory of atomspheric radiation and his work on the foundations of magnetohydrodynamics are best known. This book represents a major advance over his earlier ideas on the subject given in *The Physical Foundations of Biology* published in 1958 by Pergamon Press.

The titles of the chapters contained in this book are as follows : I. Statement of Basic Principle ; II. Statistics and the Concept of Immensity ; and III. The Meaning of Logical Complexity.   C. V. R.

Annual Review of Nuclear Science (Vol. 15). Edited by Emilio Segre. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A., 1965: Pp. 502. Price $ 8.50 per copy postpaid (U.S.A.), $ 9.00 postpaid (elsewhere).

The contents of this volume are as follows : 1. Solid-State Track Detectors : Applications to Nuclear Science and Geophysics, by R. L. Fleischer, P. B. Price, and R. M. Walker ; 2. Photonuclear Reactions, by M. Danos and

E. G. Fuller ; 3. Masses of the Metastable Particles, by Walter H. Barkas ; 4. Chemical Effects of Nuclear Transformations in Inorganic Solids, by Garman Harbottle ; 5. Radiation Chemistry of Aqueous Solutions, by Edwin J. Hart ; 6. Waste Management, by John O. Blomeke and J. Tom Roberts ; 7. Movement of Fall-out Radionuclides through the Biosphere and Man, by C. L. Comar ; 8. Dose Response Relationships, particularly in Mammalian Radiobiology, by R. H. Mole ; 9. Non-spherical Nuclei, by John D. Rogers ; 10. Reactions between Complex Nuclei, by K. R. Greider ; 11. Spin and Parity Determination of Elementary Particles, by Robert D. Tripp ; 12. Weak Interactions (First Section), by T. D. Lee and C. S. Wu ; and 13. Some Related Articles Appearing in other Annual Reviews.   C. V. R.

Science of Weather. By Professor John Day. (Addison Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. x + 214. Price $ 5.25.

This text is designed to carry the non-science major through a valid experience in science, using weather as vehicle.

In each of the two major areas of concern—circulation and precipitation—basic physical principles are introduced before discussion of the topic. The student is thus exposed to the idea that "weather" is the end result of an intricate sequence of energy transformations, each of which can be expressed through basic physical laws. This approach yields insights characteristic of science application. A causal chain of reasoning is provided from each particular phenomenon back to its underlying principle. Explored in particular detail are the causes of the precipitation process, an aspect of weather which the author feels is of special significance in an increasingly water-thirsty world.   C. V. R.

Blood Groups of Animals : Proceedings of International Conference. By Dr. W. Junk. (Publishers, 13 van Stolkweg, The Hague, Netherlands), 1967. Pp. 498. Price 25 dutch guilders, $ 6.95.

This volume contains the proceedings of an international conference on Animal Blood Group (ABG) organized by the Laboratory of Physiology and Genetics of Animals, Czechoslovak Academy of Sciences, in Prague from 18 to 22 August 1964, under the auspices of the European Society for Animal Blood Group Research (ESABR). It is interesting to trace the history

of this Society. In 1954 a small group of four European scientists working on cattle blood groups in their respective countries met in Copenhagen to discuss common problems, especially in the production of anti- and test sera. In the years to follow this group increased very rapidly, and so did their activities. More and more extensive comparison and collaboration programmes ensued as a result of their annual meetings since then. The expanding group formed a Society called European Society for Animal Blood Group Research. The meeting of 1954 has been retrospectively designated the First European Conference on Animal Blood Group. Thus the 1964 meeting becomes the 9th European ABG Conference and the First Conference of ESABR.

About 120 scientists from 22 countries participated in this conference. The publication contains 60 papers presented and discussed in plenary and separate sections, grouped under the following heads : Blood groups in cattle ; Blood groups of pigs.; Blood groups in chickens, ducks, rabbits, rats and mink ; Blood groups and serum protein polymorphism in horses; Serum protein polymorphism in man, cattle, sheep, etc. ; Protein polymorphism in some sexual gland fluids ; Immunological tolerence and transplantation antigens ; and Related questions.   A. S. G.

Guaianolides and Germacranolides. By Frantisek Sorn and Ladislav Dolejs. (Holden-Day, Inc., 728 Montgomery Street, San Francisco 11, California, U.S.A.), 1966: Pp. 153. Price $ 10.75.

This is a publication in the Chemistry of Natural Products Series edited by Edgar Lederer. Researches on sesquiterpene compounds are of comparatively recent origin. Use of modern chemical techniques for analysis and separation, as well as physical methods for elucidation of structure have considerably extended our knowledge of these compounds. Sesquiterpene lactones have proved to be insecticides. The authors of this compilation belong to the Institute of Organic and Biochemistry of the Czechoslovak Academy of Science which has been doing considerable original investigations on these compounds. Written directly into English, this book summarizes the knowledge of the two most important

groups of new sesquiterpene lactones, namely, the guaianolides and germacranolides.
                                      A. S. G.

Deformation and Strength of Materials. By P. Feltham. (Butterworth and Co., Ltd., 88, Kingsway, London W.C. 2), 1967. Pp: 135. Price 25 *sh.*

Growing interest on the synthesis and use of new materials has focussed attention on fundamental researches on properties of such substances as alloys, ceramics, semiconductors, polymers, cellular fluids, etc. In fact 'materials science' in its own right has become an essential department in research establishments of science and technology ; it also occupies an important place in university curricula in science and engineering.

A book on the subject which gives the necessary theoretical grounding will be quite welcome to students. The present little monograph develops the theoretical foundations of materials science in a concise and effective manner. It deals with their mechanical properties including elasticity, viscoelasticity and damping, strength of crystals, dislocation theory, fracture and fatigue, and behaviour of non-Newtonian fluids.   A. S. G.

Corrigendum

The titles of the two text-books on Botany reviewed on p. 222 of *Current Science,* April 20 1967, should *read* as follows : An Introduction to Gymnosperms and Structure and Reproduction of the Gymnosperms.

The price of the second book by B. S. Trivedi and D. K. Singh is Rs. 8·50 only for the students and not Rs. 18·50.

Books Received

Useful Plants of Bradil. By W. B: Mors, C. T. Rizzini. (Holden–Day, Inc., 500 Sansome St., Sanfrancisco), 1966. Pp. xiii + 166. Price $ 11.0.

Science and the Modern World. Edited by J. Steinhardt. (Plenum Press, New York), 1966. Pp. x + 225. Price $ 7.50.

Agricultural Microbiology. By G. Rangaswami. (Asia Publishing House, Bombay), 1966. Pp. xiii + 413. Price Rs. 25·00.

Stoicheometry. By L. K. Nash. (Addison–Wesley Publishing, Co., Reading, Mass.), 1966. Pp. x + 182. Price $ 3.95.

FOURIER TREATMENT OF THE ANOMALOUS DISPERSION CORRECTIONS IN X-RAY DIFFRACTION DATA *

R. SRINIVASAN AND K. K. CHACKO

Centre of Advanced Study in Physics, University of Madras, Madras-25, India

1. INTRODUCTION

THE use of anomalous dispersion effect in X-ray scattering for the solution of crystal structure and absolute configuration of molecules is now well known (Peederman and Bijvoet, 1956; Ramachandran and Raman, 1956; Pepinsky and Okaya, 1956). It is essentially based on the fact that for a non-centrosymmetric crystal containing anomalous scatterers the intensities of inverse reflections become unequal. A formal treatment of the effect results in complex quantities in the transform space and is a consequence of the fact that the atomic scattering factor itself is no longer real but a complex quantity. Thus the Patterson function, in the presence of anomalous dispersion effect, can be represented as a complex one (Pepinsky and Okaya, 1956) whose imaginary component termed the $P_s(u)$ function has interesting properties and holds the solution to the structure and absolute configuration. It is obvious that the electron density function can also be similarly represented, in a formal way, as a complex function. No explicit treatment of this seems to be available in the literature particularly from the point of view of practical calculations. The purpose of this paper is to derive the related formulæ and to show how such a Fourier synthesis can be computed in practice from the available data. This method of approach is likely to prove useful in the study of the real and imaginary components of the dispersion corrections to the atomic scattering factors.

2. FOURIER REPRESENTATION OF COMPLEX ELECTRON DENSITY

Let N denote the total number of atoms in the structure, P the number of anomalous scatterers all of the same kind and Q the number of non-anomalous scatterers. Denoting the atomic scattering factors by

$$f_P = f_P^0 + \triangle f_P' + i\triangle f_P'' = f_P' + i\triangle f_P''$$
and $f_Q = f_Q^0$, the structure factors for the

reflections H and $\bar{H}$ can be written as

$$F(H) = F'(H) + iF_P''(H) \qquad (1\,a)$$

$$F(\bar{H}) = F'(\bar{H}) + iF_P''(\bar{H}) \qquad (1\,b)$$

and in particular,

$$F^*(\bar{H}) = F'(H) - iF_P''(H) \qquad (1\,c)$$

where F' is the contribution to the structure factor from the total real parts of the scattering of the atoms (*i.e.*, from f'_P and f_Q) and F_P'' is the contribution from the imaginary part $\triangle f_P''$ of the anomalous scatterers. Written in terms of the real and imaginary components of the structure factors (1) becomes

$$F(H) = [A'(H) - B_P''(H)] + i[B'(H) + A_P''(H)]. \qquad (2\,a)$$

$$F(\bar{H}) = [A'(H) + B_P''(H)] + i[A_P''(H) - B'(H)] \qquad (2\,b)$$

and

$$F^*(\bar{H}) = [A'(H) + B_P''(H)] + i[B'(H) - A_P''(H)] \qquad (2\,c)$$

where

$$A'(H) \sum_{i=1}^{Q} f_{Qi} \cos 2\pi H \cdot r_{Qi} + \sum_{j=1}^{P} f_{Pj}' \cos 2\pi H \cdot r_{Pj}$$

$$A_P''(H) \sum_{j=1}^{P} \triangle f_{Pj}'' \cos 2\pi H \cdot r_{Pj} \qquad (3)$$

and similarly the B components are given in terms of sine functions. (It is understood that quantities with no subscript correspond to the entire structure of N atoms.)

The electron density distribution $\rho(r)$ can be formally defined as

$$\rho(r) = \frac{I}{V} \left\{ F(O) + \sum_H \left[\frac{F(H) + F^*(\bar{H})}{2} \right] \right.$$

$$\times \exp. 2\pi i H \cdot r$$

$$+ \left. \sum_H \left[\frac{F(H) - F^*(\bar{H})}{2} \right] \exp. 2\pi i H \cdot r \right\} \qquad (4)$$

where F^* is the complex conjugate of F. It may be readily verified that (4) is the generalization of the electron density representation,

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for when anomalous dispersion effect is absent $\underline{F}(H) \equiv \underline{F}^*(\bar{H})$ and hence the second summation in (4) will vanish while the remaining terms reduce to the conventional form. In order to interpret the resultant Fourier (4) let us substitute the formulæ from (2) in (4). We get, after some simplification,

$$\rho(\underset{\sim}{r}) = \frac{1}{V} \{F(O) + 2 \sum' [A'(H) + iB'(H)]$$
$$\times \exp. 2\pi i H \cdot \underset{\sim}{r}$$
$$+ 2i \sum' [A_P'(H) + iB_P''(H)]$$
$$\times \exp. 2\pi i H \cdot \underset{\sim}{r}\} \qquad (5)$$

where the primed summation symbol denotes that the summation is over half the reciprocal cell only. Thus from (5) it is seen that the electron density can be formally written as

$$\rho(\underset{\sim}{r}) = \rho_R(\underset{\sim}{r}) + i\rho_I(\underset{\sim}{r}) \qquad (6)$$

where ρ_R and ρ_I are the 'real' and 'imaginary' components of the electron density given by

$$\rho_R(\underset{\sim}{r}) = \frac{1}{V} \{F(O) + 2 \sum' [A'(H) iB'(H)]$$
$$\times \exp. 2\pi i H \cdot \underset{\sim}{r}\}$$
$$\rho_I(\underset{\sim}{r}) = \frac{2}{V} \sum' [A_P''(H) + iB_P''(H)]$$
$$\times \exp. 2\pi i H \cdot \underset{\sim}{r} \qquad (7)$$

3. DISCUSSION

The functions ρ_R and ρ_I correspond to the total contribution to the structure factor respectively from the entire real and imaginary components of the atomic scattering factors. This is readily visualized by reference to the argand diagram (Fig. 1) where the relations between the structure factors are shown. Half the
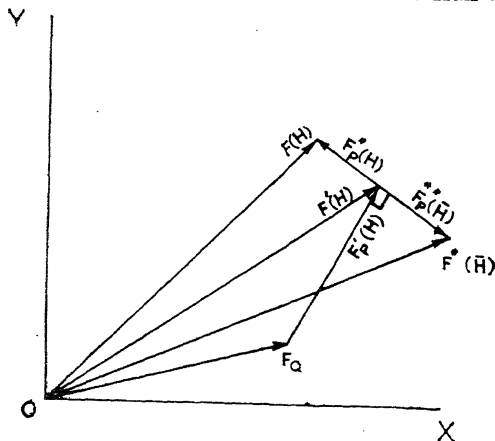
FIG. 1. Relations between the structure factors.

sum and difference of the vectors $\underline{F}(H)$ and $\underline{F}^*(\bar{H})$ may be seen to be respectively the vectors $F'(H)$ and $F_P''(H)$. It may be noticed that the i in (5) is only a consequence of the fact that the imaginary component is $\pi/_2$ ahead of the real component F_P' of the anomalous scatterers.

Our main interest here is in the fact that both ρ_R and ρ_I can be computed. For instance ρ_R is the one normally calculated. In the method of phase determination (Ramachandran and Raman, 1956) it is the phase angle α' corresponding to $\underline{F}'(H)$ that is calculated (but for an ambiguity). In the initial stages of analysis the magnitude of $|F'(H)|$ may be taken to be approximately $\langle I \rangle^{\frac{1}{2}}$ where $(I) = [I(H) + I(\bar{H})]/2$, while for greater accuracy the exact expression $|F'(H)| = [\langle I \rangle - |F_P''|^2]^{\frac{1}{2}}$ may be used (Ramachandran and Raman, 1956).

Once the structure has been established fully and well refined co-ordinates of all atoms are available one could compute the function ρ_I. The coefficients to be used here are $- i [F(H) - F^*(\bar{H})]/2$ where it is understood that one uses the observed amplitudes $|F_0(H)|$ and $|F_0(\bar{H})|$ with the calculated phases $\alpha(H)$ and $\alpha^*(\bar{H})$ which are given by

$$\tan \alpha(H) = \frac{[B'(H) + A_P''(H)]}{[A'(H) - B_P''(H)]} \qquad (8\,a)$$

$$\tan \alpha^*(\bar{H}) = \frac{[B'(H) - A_P''(H)]}{[A'(H) + B_P''(H)]} \qquad (8\,b)$$

It is clear that the map ρ_I is the Fourier transform of imaginary components of the anomalous scatterers and will contain peaks at $\underset{\sim}{r}_{Pj}$ of strength proportional to $\Delta f_P''$. It may be readily verified that the formula (4) is quite general and is applicable even when there are more than one type of anomalous scatterers in the unit cell. To start with, one could calculate the phases by including only the strongest of the anomalous scatterers but the Fourier map ρ^I can be expected to reveal the other "lighter" anomalous scatterers. The entire structure could then be developed further with successive approximations. The following are the possible lines that are open at this stage:

(*i*) The map ρ_I can now be treated independently of ρ_R and the structure refined. The positions as given by such a map may be compared with those obtained from ρ_R. Any possible differences which are significant may give us useful information of the electron

density maxima for the entire atom and the inner shells respectively.

(*ii*) The refinement of the ρ_I structure may include also $\triangle f_r''$ and its temperature factor B_J'' as unknown parameters.

The difference Fourier technique and least squares method can be useful for this purpose.

The possibility of a systematic application of these procedures depends to a large extent on the accuracy of the intensity data. In particular since it is the difference in magnitude that enters the Fourier synthesis, the map will be highly sensitive to errors in the measurements. The absolute values of $\triangle f''$ to be obtained will particularly depend on the absolute

values of $|\underline{F}(\underline{H})|$ and $|\underline{F}(\underline{\bar{H}})|$.

Coming to the function ρ_R, it is seen that it could be used to study the real part correction $\triangle f'$ and the corresponding electron density distribution. However, this requires measurement of intensities for another wavelength λ_0 for which dispersion effect is absent or negligible. The difference map $\rho_R(\lambda) - \rho_R(\lambda_0)$ can be performed to study $\triangle f'$.

It may be pointed out in this connection that the above method of approach in terms of real and imaginary components is only a formal, and convenient way of studying the dispersion effects. Actually as pointed out by Patterson (1963; see also Ibers and Hamilton, 1964) the electron density in atoms should, from a physical point of view, be independent of the wavelength used. Such a representation could still be obtained although it could be achieved only as a limiting approximation. For instance even atoms as light as oxygen have finite detectable dispersion effects (Zachariasen, 1965; Marezio, 1965) for normally used wavelengths.

Figure 2 shows the ρ_I map computed for L-tyrosine hydrochloride for the $\underline{C}$ projection.

The measured counter data of Parthasarathy (1962) were used and the co-ordinates used were those given by Srinivasan (1959). A strong peak (strength $\simeq 1 \cdot 8\ e/\text{A}^2$) at the position of chlorine may be noticed, which is to be expected. The $\triangle f''$ correction for chlorine for CuK α is $\simeq 0 \cdot 66$). There is no other significant feature in the map excepting low peaks which

appear to be spurious. It may be mentioned that this is taken only as an example to illustrate the method and is probably not the best one to see, if any, the effects at lighter atoms. The structure had been refined only two-dimensional data, and hence the accuracy in co-ordinates is not high. No attempt was therefore made to refine the ρ_I map.
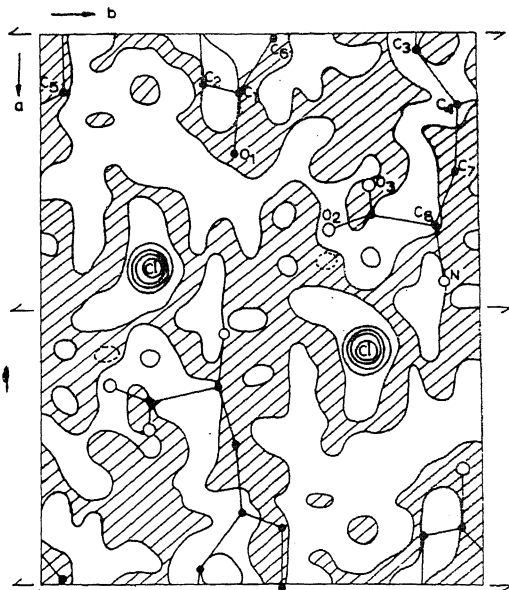
FIG. 2. ρ_I-map for L-tyrosine hydrochloride projected down the c axis.

Detailed test of these ideas on more accurate structures are in progress and will be reported in due course.

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POST-TREATMENTS AND THE EFFICIENCY OF ETHYL-METHANE-SULPHONATE

GEORGE VARUGHESE

Atomic Energy Laboratory, Indian Agricultural Research Institute, New Delhi-12

AN efficient mutagen is one which is capable of inducing maximum mutations with the minimum of lethality. The potency of ethyl-methane-sulphonate (EMS) as one of the most efficient mutagens has been proved in a wide range of organisms. The factors which control the effectiveness and efficiency of chemical mutagens are many[1-4] but are limited in comparison with physical mutagens. The action of post-treatments[4,5] in modifying the efficiency of EMS is of interest to mutation breeders. The results obtained in one of our experiments in wheat, revealing the modification of the EMS action brought about by different post-treatments, are summarised in this communication.

Seeds* of *Triticum œstivum* sub-sp. *vulgare* var. Sonora 64 were subjected† to two doses of EMS, *viz.*, 1/200 and 1/100. Control seeds as well as the treated seeds were then divided into three equal parts. The first lot was put for germination in a germinator at 20° C. while lot Nos. 2 and 3 were given 8 hours post-treatments in buffer (pH 9, borax) and distilled water respectively at 30° C. and were then germinated as the first lot. After seven days all the seedlings were transplanted in the field after recording the shoot and root growth. Survival was recorded at the time of harvest. The M_2

But the results of the M_1 and M_2 mutation frequencies show that with the reduction in seedling injury there is a coincident reduction in mutation frequency too. Since the survival is not much altered by the post-treatments and since the mutation frequency is higher in direct treatments, the efficiency of direct treatments are far higher than the post-treatments, although Msp/I reveals a reverse trend.

These results would imply that many mutations induced by EMS are delayed in origin caused by the mutagen retained in the tissue. The mechanisms governing the delayed origin of mutations in chemical treatments have been discussed by Mathew.[6] When post-treatments are given, both the chemical as well as the harmful hydrolytic products are washed away, which results in a reduced mutation rate and a higher recovery. If this explanation is true, then the same post-treatment should give different results after different durations of EMS treatments. This part of the experiment is at present underway.

TABLE I

Treatment		I	S	% of M_1 plants showing chimeras		M_2 mutation rate as			Msp/I
				Chlorophyll	Ear	Mp	Msp	Msd	
Direct control	..	0·00	100	0·00	0·00	4·17	0·84	0·02	..
Post-buffer control	..	0·00	100	0·00	0·00	4·17	0·85	0·02	..
Post-water control	..	0·00	100	0·00	0·00	0·00	0·00	0·00	..
Direct EMS 1/200	..	24·19	94·3	25·00	5·00	65·00	21·00	2·91	0·868
Post-buffer EMS 1/200	..	8·16	96·5	20·80	4·10	50·00	15·83	3·27	1·939
Post-water EMS 1/200	..	7·52	95·0	11·10	5·30	31·59	8·42	1·30	1·119
Direct EMS 1/100	..	70·76	77·1	57·10	14·30	95·24	53·92	11·82	0·762
Post-buffer EMS 1/100	..	43·48	79·2	57·80	5·30	78·94	35·41	6·15	0·814
Post-water EMS 1/100	..	34·01	78·1	46·60	6·60	66·67	24·00	4·20	0·705

I—Growth reduction of 7-day old seedlings as a % of the control. S—Mature-plant survival as a % of the control. Mp—Mutations/100 M_1 plants—Mutation frequency on a plant basis. Msp—Mutations/100 M_1 spikes—Mutation frequency on a spike basis. Msd—Mutations/100 M_2 seedlings—Mutation frequency on a seedling basis.

generation was grown on spike progeny basis keeping the identity of each spike.

The results obtained in this experiment are summarised in Table I. It can be seen that the seedling injury is maximum in direct treatments and it is the least in post-water treatments closely followed by post-buffer treatments. This confirms the earlier report.[5]

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* 14 hours pre-soaked seeds were used.

† 8 hours treatment at 30° C; in pH 7 citric acid sodium phosphate buffer.

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METHIONINE BIOSYNTHESIS IN *OCHROMONAS MALHAMENSIS*

V. H. POTTY AND D. V. TAMHANE

Department of Chemical Technology, University of Bombay, Bombay-19

BIOSYNTHESIS of methionine and thymine are the two reactions requiring the participation of both folic acid and vitamin B_{12}. Relevant works carried out in this area have been extensively reviewed.[1-3] The more recent findings suggest that the two vitamins are involved in independent discrete steps in the biosynthetic pathways involved. The conflicting reports on the role of vitamin B_{12} in methionine biosynthesis have been explained away by Woods and co-workers[4] by postulating the existence of two pathways in nature, one dependent on and the other independent of vitamin B_{12}. But so far the exact nature of the involvement of vitamin B_{12} in this vital transmethylation reaction is not very clearly understood. The present communication reports some observations on these aspects in *Ochromonas malhamensis*, a vitamin B_{12}-dependent chrysomonad.

The conditions of maintenance, growth and harvesting were as described in an earlier report.[5] For the present studies a basal medium similar to the one used by Johnson *et al.*[6] was employed with either 0·4 mμg. B_{12} or 600 μg. of *dl*-methionine per ml., depending on the type of cells required. Methionine synthesis was carried out using 5-day grown cells, thoroughly washed free of adhering medium. The reaction system consisted 0·01 M *dl*-homocysteine, 0·01 M *dl*-serine and respiring cells, equivalent to 15–20 mg. on dry weight basis, in a final volume of 5 ml. of 0·1 M phosphate buffer, pH 7·0. The system was incubated at room temperature for 6 hr., reaction stopped by steaming for 5 min., centrifuged and the supernatant, after adjusting the pH to 6·8, made to volume. Aliquots were used for methionine estimation with *L. fermenti* as test culture.[7] Cells, grown in presence and absence of vitamin B_{12}, were extracted in 1% ascorbate solution of pH 6·0 and subjected to DEAE-cellulose chromatography for separation of folate derivatives, as described elsewhere.[5]

The results in Table I indicate that variation of vitamin B_{12} concentration in the medium results in varying growth response ; but the methionine synthesising capacity of the organism is not affected to the same extent. This points to the relatively small amount of vitamin B_{12} required for this transformation. This supposi-

TABLE I

Effect of vitamin B_{12} on synthesis of methionine in vitro by O. malhamensis

Vitamin B_{12} in growth medium mμg./100 ml.	Per cent growth	mμ moles of methionine synthesised per mg. dry weight of cells in 6 hr.
0·0	35·4	1·00
2·5	34·4	6·77
5·0	63·7	8·58
10·0	78·2	9·45
40·0	100·0	9·99
100·0	107·8	10·59

The growth obtained with 40 mμg. of vitamin B_{12} per 100 ml. was taken as 100%. In experiments without vitamin B_{12}, the medium was supplemented with 60 mg. of *dl*-methionine per 100 ml. Other details are as described in the text.

tion is supported by the observation of Johnson *et al.*[6] who obtained a complete reversal of growth inhibition due to ethionine with homocysteine and traces of vitamin B_{12}. At the same time the absolute requirement of vitamin B_{12} is demonstrated by the negligible methionine synthesis by cells grown only with methionine. Even incubation of these cells with vitamin B_{12} up to 3 hr. does not confer upon them the ability to form methionine from homocysteine. This could be interpreted to mean that the apoenzyme, a part of the cobamide-enzyme responsible for the transfer of methyl group from N^5-methyltetrahydrofolic acid to homocysteine is absent in methionine-grown cells. The folic acid patterns of both vitamin B_{12}-, and methionine-grown cells do not differ much (Fig. 1) which rules out the possibility of an impaired folic acid metabolism causing inactivation of methionine synthetase system.

In view of the above observations it could be reasonably surmised that the presence of vitamin B_{12} in the growth medium is absolutely essential for the cells to acquire methionine synthesising capacity. Woods *et al.*[8] also noticed the presence of cobamide enzyme in all strains of *Esch. coli* only when they were grown in presence of vitamin B_{12}. The reported failure of Dalal *et al.*[9] to substitute the heated cell extract of *O. malhamensis* by various co-factor
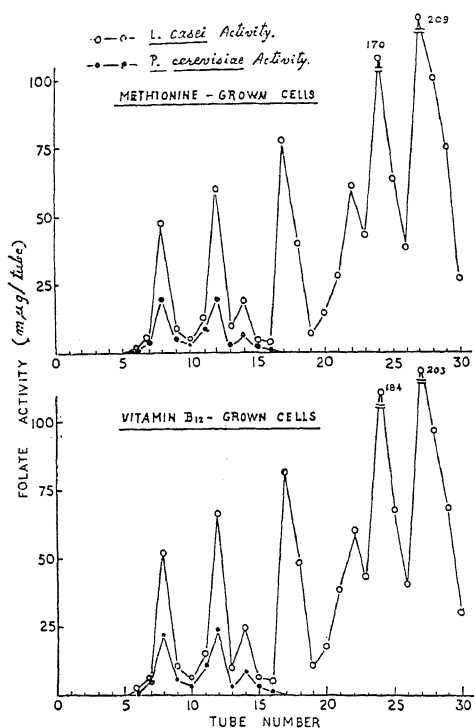
FIG. 1. Folate pattern of *O. malhamensis* as affected by presence and absence of vitamin B_{12} in the growth medium. (The organism was grown in presence of either 0.4 mμg. vit. B_{12} or 0.6 mg. *dl* methionine per ml. The folates extracted and chromatographed on DEAE-cellulose column. The eluted fractions were assayed with *L. casei* and *P. cerevisiae* as test organisms.)

mixtures in the reaction system also supports such a supposition.

SUMMARY

Inclusion of vitamin B_{12} in the growth medium is a prerequisite for the acquirement of methionine synthesising activity by *Ochromonas malhamensis*. Cells grown in absence of vitamin B_{12} lost permanently their ability to form methionine from homocysteine. No difference in folic acid patterns could be observed between cells grown with and without vitamin B_{12}.

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SCLEREIDS OF *GNETUM ULA* AND *G. GNEMON*

A. R. RAO AND MANJU MALAVIYA (MISS)
Department of Botany, University of Lucknow

THE structure and distribution of sclereids in living Gymnosperms has received little attention. Bower[1] mentioned the presence of "sclerenchymatous idioblasts" in *Welwitchia*. Rodin[2-5] in *Welwitchia* and *Gnetum*, Maheshwari and Vasil[6] in *Gnetum*, Rao and Malaviya[7-14] in conifers and Rao[15] in *Agathis, Podocarpus* and *Gnetum* have made a systematic study of sclereids. The present note incorporates some further observations on the development, struc-ture and distribution of brachy, osteo and astrosclereids which occur in all the organs of *Gnetum ula* Brongn and *Gnetum gnemon* L. Usual techniques of clearing and staining were followed.[16-17]

It is found that in both the species sclereids are present in stem (Figs. 1 and 2, Photo 1), leaf petiole and (Figs. 3 and 4) male and female cone-axes, sporophylls (Figs. 5 and 6, Photos 2-4) and ovule wall (Fig. 7). In all these
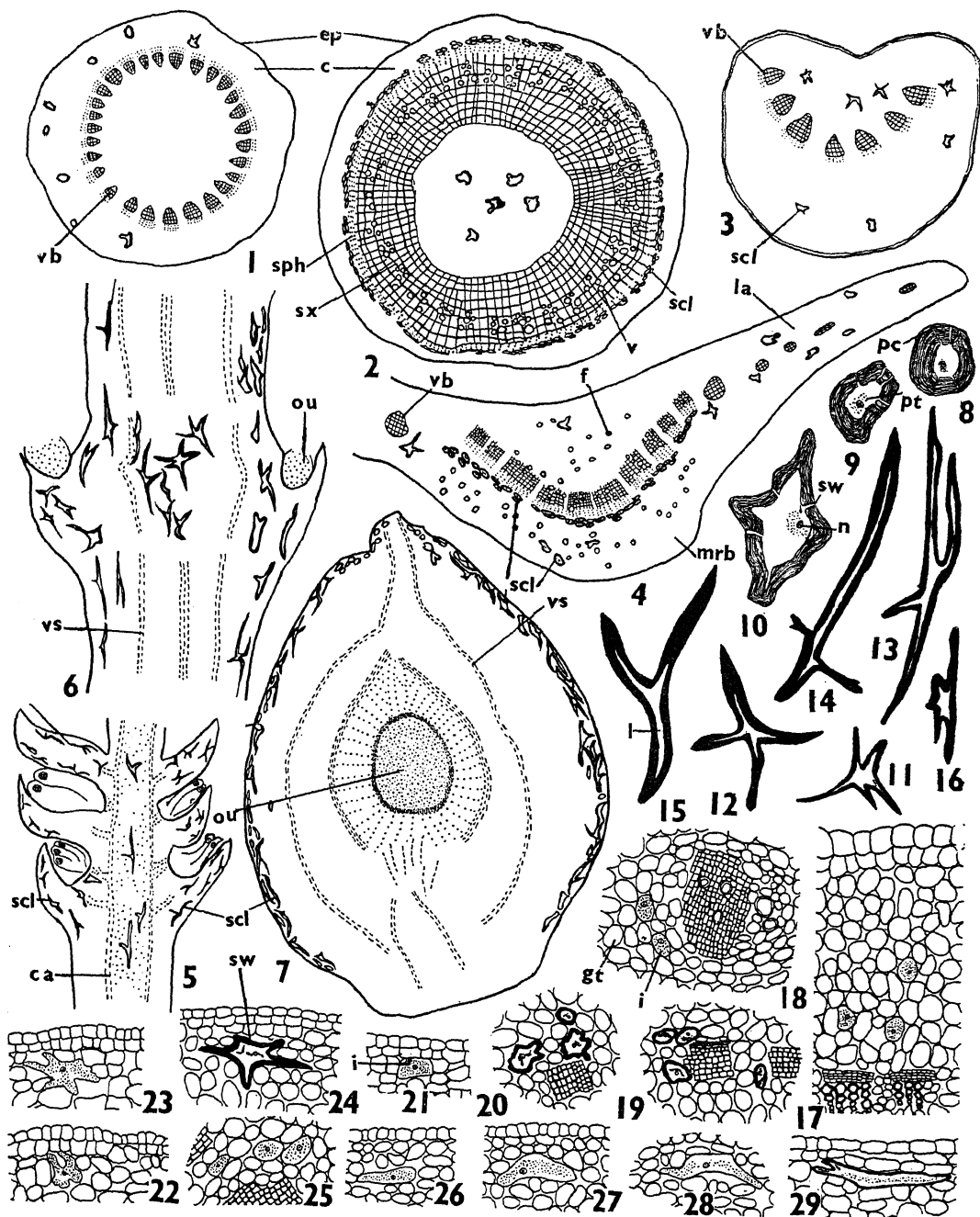
FIGS. 1-29. Figs. 1-7. Diagrammatic representations of transections and longitudinal sections of primary stem, secondary wood, petiole, leaf, male cone, female cone and ovule respectively showing the distribution of sclereids, × 1-3, × 70, 4-7, × 22. Figs. 8-10. Magnified brachysclereids and a small astrosclereid, × 550. Figs. 11-12. Astrosclereids, × 100. Figs. 13-16. Osteo sclereids and bizarre sclereids, × 100. Figs. 17-18. Sclereid initials in primary stem and secondary wood, × 360. Figs. 19-20. Development of brachy and small astrosclereids in stem, × 360. Figs. 21-24. Development of astrosclereids in the sporophyll, × 360. Figs. 25-29. Stages in the development osteosclereids, × 360. (*c*, cortex; *ca*, cone-axis; *ep*, epidermis; *f*, fibre; *gt*, ground tissue; *i*, initial; *l*, lumen; *la*, lamina; *mrb*, midrib; *n*, nucleus; *ou*, ovule; *pc*, pit canal; *pt*, protoplast; *scl*, sclereid; *sw*, secondary wall; *sx*, secondary xylem; *v*, vessel; *vb*, vascular bundle; *vs*, vascular supply).
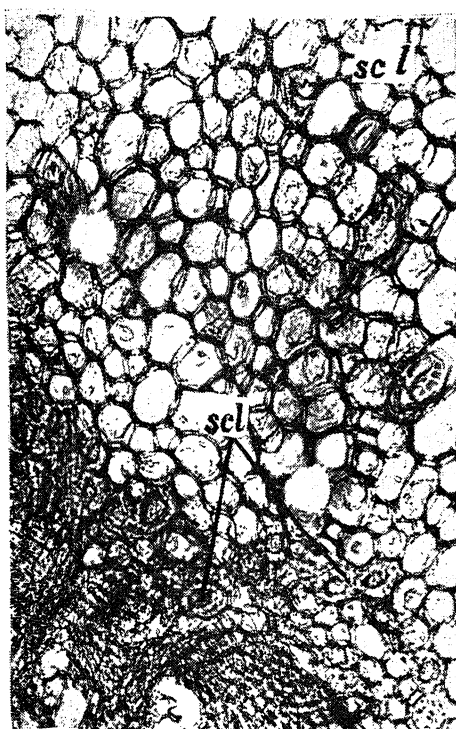
PHOTOS 1-4. Photo 1. T.s. of stem showing the distribution of sclereids in the cortex and in between the xylem, × 141. Photo 2. Cleared mount of L.S. of female cone axis showing numerous sclereids, × 37. Photo 3. Various forms of sclereids from female cone, × 144. Photo 4. L.S. of male cone showing sclereids, × 38. (*gt*, ground tissue; *scl*, sclereid.)

organs the form of the sclereid is generally dependent upon the nature of the surrounding tissue to some extent. In the stem cortex and pith where the ground tissue is compact generally brachysclereids (Figs. 8 and 9) are found with very small astrosclereids (Fig. 10). In the leaf midrib region brachysclereids occur, but in the spongy mesophyll with plenty of intercellular spaces astrosclereids develop (Figs. 11 and 12). In the sporophyll, and the wall of the ovule and in the cone–axes where loosely arranged ground tissue occur osteo- (Figs. 13 and 14), astro- and Y- (Fig. 15) or T-shaped (Fig. 16) bizarre types of sclereids predominate. The secondary wall of all these sclereids is very thick, lignified, lamellated and traversed by pit-canals. The lumen generally contains some remnants of disorganised protoplast and also a persistent nucleus (Figs. 8-10). The sclereids can be classified in Gnetum on the basis of their form according to Tschirch's classification.[18] T. A. Rao[15] however refers to these sclereids as filiform, fusoid and stellate and gnarled cells.

In the stem, brachysclereids are developed in rows or groups, by the "secondary sclerosis" of well-differentiated, parencymatous sclereid initials. These are uninucleate and easily recognisable by their dense protoplasmic contents (Figs. 17 and 18) both in primary and secondary stems. The initials increase in size, the contents gradually degenerate and the "secondary sclerosis" of the wall takes place. This leads to the formation of oval or rounded or isodiametric, brachysclereids (Figs. 19 and 20).

The micro and mega sporophylls have osteo- and astro–sclereids and are generally deviod of brachysclereids. Their development involves both "intrusive" and "symplastic" growth. The initials (Fig. 21) similar to those of the stem, put forth small, tubular arms into the surrounding intercellular spaces (Figs. 22–24). The protoplasm generally migrates into the growing arms which further elongate by intrusive growth and ultimately undergo lignification of the wall. All further growth ceases, and the protoplast starts disorganising, resulting in the formation of astrosclereids.

Other initials elongate first (Figs. 25–29) and then produce short branches at their ends. After sufficient increase in length, sclerification of the wall sets in leading to the formation of osteosclereids (Fig. 29). The nucleus generally persists in the adult sclereids of all the types.

Brachy, osteo, astro and bizarre sclereids occur in all the vegetative parts, except the roots and also in the fertile parts of *Gnetum ula* and *G. gnemon.* In the primary stem, brachysclereids occur between the vascular bundles and above them. After the secondary growth, the sclereids are found in close proximity to the bast-fibres and thus probably contributing towards the building up of a mechanical tissue cylinder in the secondary woods. All the other plant parts are also fairly tough in texture as sclereids are present in them in large numbers.

So far as has been investigated, *Gnetum* sclereids do not possess crystals which are reported in sclereids of *Welwitchia mirabilis* by Rodin.[2-5] The adult sclereids of *Gnetum* have a persistent nucleus while those of *Welwitchia* do not have. These two features may be added to the list of morphological and anatomical differences recognised between these two genera. When other species of *Gnetum* are investigated, then some specific differences may also appear in sclereid features.

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LETTERS TO THE EDITOR

ISOTOPE EFFECT IN NEUTRON IRRADIATED n-BUTYL BROMIDE

THE author has already reported[1-2] the isotope effect observed in radiobromine produced in the (n,γ) process with C_6H_5Br, C_2H_5Br, $C_2H_4Br_2$ and CH_2Br_2 making use of the charged plate technique. The present work, further, supports the success of the technique adopted for observing the difference in the isotopic yields in radiobromine produced under thermal neutron irradiation with n-butyl bromide. The results obtained regarding the characteristic values (β/σn) of Br-80 and Br-82 show that the adopted technique seems to be a general one so far as the study of isotope effect is concerned in radiobromine in liquid phase with bromide compounds. Recent work of Milman,[3] following the gas chromatography technique, indicates the existence of isotope effect on irradiation of C_2H_5Br in liquid phase confirming one of our previous findings.

In isotope effect study of Br-80 and Br-82, about 250 ml. of n-butyl bromide were irradiated for a duration of nine days with a Ra + Be source of 300 mC. Towards the end of irradiation, the irradiated liquid was subjected to an electric field of 200 volts/cm., for periods of 1·5 hr. and 5 hr. to observe the effect on either electrode. The results obtained from the analysis of the decay curve of the collected radioactive species and the calculated relative yields with the help of available cross-section (σ) and abundance (n) are given in Table I.

invariably been observed. Moreover, the findings of Br-80 and Br-82 suggest that there is a similarity in the behaviour of Br-80 and Br-82 recoiled atoms so far as their collection on the electrodes is concerned. The discovery of Br-82 m level by Emery and Anders[4] supports our experimental results regarding the behaviour of Br-82 atoms.

Due to high internal conversion and Auger effect it is expected that Br-80 and Br-82 formed through the corresponding metastable states should be in positively charged states[5,6] of high order resulting in a greater enrichment on the cathode. However, present observations point out that it is the eventful life of the initially charged fragments in the liquid that determines on which electrode they will be deposited. According to 'Auger Electron Hypothesis' the reaction $RBr^* + eR^- + \to Br^*$ takes place which arises due to radiation effect as a consequence of internal conversion and Auger electrons emitted from the recoil atoms. This accounts for higher enrichment on the anode. The above reaction suggested by Geissler and Willard[7] finds support from our observations as the activity on the anode is much affected compared to that at the cathode when the duration of the applied field is small, i.e., 1·5 hr. It is clear from Table I that the isotope effect can be visualised on either electrode in case of n-butyl bromide. The fractions of the positively charged atoms may differ among the different isotopes of a given element due to

TABLE I
Isotope effect in n-butyl bromide

Duration of applied field hr.	Target data	σ (barns)	n (%)	Product yield			
				Anode		Cathode	
				β	β/σn	β	β/σn
1·5	Br-81	3·5	49·5	6900	39·8	4100	23·6
	Br-79 (4·4 hr.)	2·9	50·5	3080	20·9	320	2·1
	Br-79 (18 min.)	8·5	50·5	2055	4·7	942	2·2
5·0	Br-81	3·5	49·5	4350	25·0	2300	13·2
	Br-79 (4·4 hr.)	2·9	50·5	870	5·5	490	1·1
	Br-79 (18 min.)	8·5	50·5	2273	5·3	1132	3·1

On the electrodes charged species of both kinds of Br-80 and Br-82 and a higher enrichment of negatively charged species have

variation in their coefficients of internal conversion with capturing nuclides. This accounts partly for the occurrence of isotope effect,

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INCOHERENT SCATTERING OF GAMMA RAYS IN LEAD

To study the effect of electron binding on the incoherent scattering of gamma rays the procedure is followed: first ... determined total experimentally ... the contribution due to the coherent ... partial cross-sections ... scattering cross-sections are subtracted. The ratio the remainder of ... to the theoretically calculated integral free electron scattering cross section σ_0 is taken as a measure of the effect of electron binding on the incoherent scattering of gamma rays. Such procedures are already in use. As the binding effect decreases, the value of the ratio approaches unity and finally becomes unity when there are no binding effect. With a view to study the effect and its variation with energy in lead, the ratio $(\sigma_b/\sigma_f)_{exp}$ is determined using the available experimental total cross section; theoretical coherent scattering cross-section and the recently revised photoeffect data on the photoelectric cross-sections at 32, 411 and 662 keV gamma energies. The differential free electron scattering cross-sections are numerically integrated after correcting for the binding effect at each angle using the form functions of Thomas Fermi given in the NBS Circular, to get the integral bound electron scattering cross-section σ_b. The ratio of this value to the free-electron scattering cross-section σ_f gives the theoretical ratio $(\sigma_b/\sigma_f)_{theoret.}$. The results are given in Table I.

It can be seen from Table I that the effect of electron binding is severe at low energies and it finally seems to diminish to zero around 662 keV gamma energy. The variation in the theoretical values with energy is not as severe as in the case of experimental values. The **experimental value at 320 keV energy largely**

TABLE I

		( )		( )	
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	...	...	...	...	...

...

... ... R. Parthasarathi
Physics Department ... V. Venkateswara Rao
... ... Madras, March 4, 1967

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RELAXATION TIMES AND DIPOLE MOMENTS OF SOME ESTERS

During the dielectric investigation, the dielectric constant and the loss factor of methyl benzoate, ... ethyl benzoate, n-amyl benzoate, ... methyl salicylate, n-amyl salicylate and phenyl salicylate have been measured at room temperature 25° ± 1°C ... at a frequency of 9314 Mc/s in dilute solution in benzene. The dielectric constant at a frequency of 1 Mc/s and the refractive index for the sodium D line have been determined in benzene solution of the same composition at the same temperature applying Gopalakrishna's method to the microwave measurements and Guggenheim's method to the radiofrequency measurements, the relaxation times and the dipole moments have been evaluated for these molecules, and are presented in Table I.

The dipole moments are estimated to be accurate to ± 3 to 5% and the relaxation times to 15 to 20%.

The observed dipole moments of the four benzoates studied are more or less the same, although they may be expected to be a little different for the ... benzoates. As for the salicylates, the observed radiofrequency moment value of phenyl salicylate agrees reasonably well with one of the two values in the same

TABLE I

| Molecule | Microwave | | Radio-frequency |
	Relaxation time τ in picoseconds	Dipole moment μ in Debye units, D	Dipole moment μ in Debye units, D
Methyl benzoate ..	6·3	1·92	1·93
Iso-propyl benzoate ..	9·3	1·82	1·97
Iso-butyl benzoate ..	12·0	1·84	1·93
n-amyl benzoate ..	13·4	1·86	1·98
Ethyl salicylate ..	8·5	2·20	2·70
Iso-butyl salicylate ..	13·1	2·26	2·74
n-amyl salicylate ..	14·5	2·09	2·76
Phenyl salicylate ..	9·3	1·92	2·38

solvent in the literature,[4,5] namely, 2·24 D ; it differs, however, from those of the other salicylates investigated, probably because of the substitution of a ring radical (phenyl radical).

The relaxation times are in general of the right order of magnitude.

Department of Physics,   R. L. PATIL.
Karnatak University,   K. SURYANARAYANA RAO.
Dharwar-3, *February* 22, 1967.

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ADDITION OF DICHLOROCARBENE TO CAMPHENE

COMPREHENSIVE studies of the reactions related to the addition of dichlorocarbene to norbornylene systems have recently been made in several laboratories[1-5] with almost concordant results. The ultimate result of these reactions was ring enlargement as depicted below (Fig. 1).
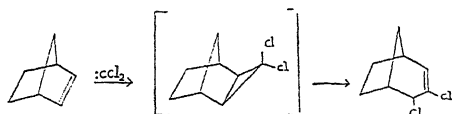
FIG. 1.
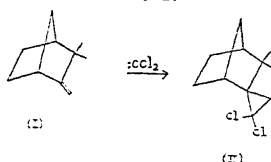
FIG. 2.

We have studied the addition of dichlorocarbene to camphene (I) and obtained a product (in 10% yield) which appears to be a gem-

dichloro-derivative of camphene (II) from the infrared and NMR evidence (Fig. 2).

In the infrared spectrum of the adduct (II), the absence of a band at 1620 cm.⁻¹ indicates that the double bond is attacked by the dichlorocarbene. Its I.R.[6] has absorption bands at 2990, 1047, 1020 (cyclopropane CH₂), 1470 (–CH₂), 1370 (–CH₃), 909, 877 (cyclohexane and cyclobutane rings) 806 (–CH) and 757 (C–Cl) cm.⁻¹ The NMR spectrum (in CCl₄) has no signal for any unsaturated proton in the range 4·7 τ. However, it depicts several saturated protons at 9·97, 9·78, 9·44, 9·34, 8·9, 8·78, 8·50, 8·1 and 8·0 τ. Thus the NMR and infrared results support structure (II) for the adduct.

Chloroform (27 g, ·23 mole) was added dropwise (in a period of 4 hr.) to a constantly stirring slurry of potassium *t*-butoxide (from 15 g. potassium and camphene (30 g., ·23 mole) in olefin-free petroleum ether at − 10 to − 5°. After complete addition of chloroform the mixture was further stirred for 2 hr. at 0°. It was then allowed to stand at room temperature for 36 hr. and then poured into water (500 ml.). The aqueous layer was extracted with petroleum ether. The combined organic layers were dried over anhydrous magnesium sulphate. Recovery of petroleum ether gave a dark brown liquid which on distillation yielded camphene (26·5 g, 85%) and a colourless liquid at 80–85°/0·5 mm. (2·5 g, 8–10%). The latter fraction was redistilled to yield a TLC pure (ethyl acetate : benzene :: 1 ; 25) sample. Its element analysis (found : C, 59·99 ; H, 7·60 ; Cl, 32·30, required for C₁₁H₁₆Cl₂—C, 60·29 ; H, 7·4 ; Cl, 32·40%) is in agreement with the dichloroadduct of camphene (II). The adduct does not give any colour reaction with tetranitromethane.

School of Studies   M. K. SAXENA.
   in Chemistry,   M. M. BOKADIA.
Vikram University,
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CADMIUM (II) COMPLEXES WITH QUATERNARY HALIDES

THE tetrahalo complexes of zinc and mercury have been reported[1] earlier. The formation of complex cadmium halide anions in solution has been studied[2] potentiometrically by Leden who found only CdX_3^- and $CdX_4^=$ ions, but none higher. In this communication, we report some solid halo complexes obtained by reacting cadmium chloride and bromide with some quaternary halides.

An ethanolic solution of cadmium halide was treated with an ethanolic solution of quaternary halide in 1 : 2 proportion. The separated compounds were suction filtered, washed with ethanol, then with petroleum ether and finally dried *in vacuo*. The purity of the isolated compounds was established by estimating the metal and the halogen by standard methods. The relevant analytical and conductance data are given in Table I.

as nujol mulls were recorded using a Unicam SP 200 spectrophotometer with rock-salt optics and the absorption bands are reported in Table II.

As seen from the results in Table I, all the compounds have the general formula $[M]^+$ $[CdX_3]^-$ where X is either chloride or bromide even though the experimental conditions are favourable for the formation of a $[CdX_4]^=$ anion similar to $[ZnX_4]^=$ and $[HgX_4]^=$ reported[1] earlier. Their insolubility in acetone indicates that they are electrolytes and the molar conductance values of these compounds which are sufficiently soluble reveal that they are 1 : 1 electrolytes. Recently, evidence was obtained[3] for the presence of tetrahalide ions in melts of KCl and $CdCl_2$. $[CdX_3]^-$ and $[CdX_6]^{-4}$ were not present in such mixtures in more than minor concentration. The tetrahalide ion was also reported[4] in some heterohalo cadmates. In the complexes under report,

TABLE I

Analysis, M.P. and conductance of cadmium (II) complexes with quaternary halides

Name of the complex	Formula	M.P. (°C.)	% calcium Calculated	% calcium Found	% halogen Calculated	% halogen Found	Λ M (mhos) (in acetone)
Tetramethyl ammonium trichloro cadmium (II)	$[(CH_3)_4N]^+[CdCl_3]^-$	>260°	38·4	37·4	36·3	36·3	Insoluble
Tetramethyl ammonium tribromo cadmium (II)	$(CH_3)_4N$ $CdBr_3$	>260°	26·3	25·4	56·2	55·4	205
Tetraethyl ammonium trichloro cadmium (II)	$(C_2H_5)_4N$ $CdCl_3$	>260°	32·2	33·3	30·5	30·5	Insoluble
Tetraethyl ammonium tribromo cadmium (II)	$(C_2H_5)_4N$ $CdBr_3$	>260°	26·3	25·4	56·2	55·4	138
Tetraphenyl phosphonium trichloro cadmium (II)	$(C_6H_5)_4P$ $CdCl_3$	238°	20·1	18·8	19·0	18·5	224
Tetraphenyl arsonium trichloro cadmium (II)	$(C_6H_5)_4AsCdCl_3$	220°	18·7	18·3	17·7	17·9	Insoluble

TABLE II

Infra-red absorption bands (cm.⁻¹) in nujol mulls of cadmium (II) complexes with quaternary halides

$(Me_4N)(CdCl_3)$	$(Me_4N)(CdBr_3)$	$(Et_4N)(CdCl_3)$	$(Et_4N)(CdBr_3)$	$(Ph_4P)(CdCl_3)$	$(Ph_4As)(CdCl_3)$
740 (br)	740 (w)	740 (br)	750 (sh)	710 (s)	705 (w)
975 (Vs)	970 (Vs)	800 (Vs)	795 (s)	742 (Vs)	760 (br)
1490 (sh)	1492 (s)	1020 (Vs)	1010 (s)	778 (w)	1015 (w)
..	..	1070 (w)	1065 (w)	1018 (w)	1095 (s)
..	..	1180 (Vs)	1180 (s)	1122 (Vs)	..

s = sharp, Vs = Very sharp, w = weak, Sh = shoulder, br = broad.

The magnetic susceptibility measurements were made over solid specimens at room temperature using Gouy method and all the compounds were found to be diamagnetic. The infra-red absorption spectra of these complexes

however, there was definite evidence for the presence of only $[CdX_3]^-$ ion in solid compounds. The co-ordination number of divalent cadmium, like its congeners zinc and mercury, will be four utilising the tetrahedral sp^3 hybrid orbitals.

This can be facilitated by the formation of a halogen bridge as shown below:

$$\left[\begin{array}{c} X \\ X \end{array} \!\!\! \diagdown \!\!\! Cd \!\!\! \diagup \!\!\! \begin{array}{c} X \\ X \end{array} \!\!\! \diagdown \!\!\! Cd \!\!\! \diagup \!\!\! \begin{array}{c} X \\ X \end{array} \right]^{=}$$
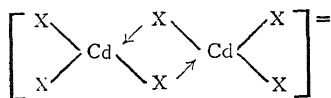
The electrolytic complexes usually have a poor solubility in organic solvents like acetone and the presence of this dimeric bridged anion reduces the solubility still further as observed.

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Dept. of Chemistry,   BIKARTAN PAUL.
Regional Engineering   D. V. RAMANA RAO.
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COMPLEXES OF COBALT (II) FERROCYANIDE

HEXACOORDINATED complexes of cobalt (II) ferrocyanide with ammonia, ethylene and propylenediamine have been synthesised. Their structure has been attempted to be discussed on the basis of their visible electronic absorption spectra.

All the three complexes could be prepared by treating calculated quantity of cobalt (II) ferrocyanide in acetone, with a little excess of anhydrous amine in acetone and shaking the reaction mixture for several days. At the end of this period, a reddish-brown stable crystalline complex was obtained, which was filtered, washed repeatedly with acetone, dried over P_4O_{10} and analysed.

1. $[Co(NH_3)_6]_2$ $Fe(CN)_6$.—Found Co = 22·20%, M = 47·33%, NH_3 = 38·31%, $Fe(CN)_6$ = 39·48%; Calculated values are Co = 22·10%, N = 47·22%, NH_3 = 38·22%, $Fe(CN)_6$ = 39·70%.

2. $[Co(NH_2.CH_2.CH_2.NH_2)_3]_2$ $Fe(CH)_6$.—Found Co = 17·13%, N = 36·41%; Cs = 52·01; $Fe(CN)_6$ = 30·4%; Calculated: Co = 17·02%, N = 36·65%, Cu = 52·20%, $Fe(CN)_6$ = 30·80%.

3. $[Co(NH_2.CH_2.CH_2.CH_2.NH_2)_3]_2 Fe(CN)_6$.—Found Co = 15·21%, N = 32·36%; Pn = 57·31%, $Fe(CN)_6$ = 27·06%; Calculated: Co = 15·14%, N = 32·60%, pn = 57·42%; $Fe(CN)_6$ = 27·40%.

Cobalt was estimated as its α-nitroso β-naphthol complex and ferrocyanide volumetri-

cally using chloromine-T.[1] Total amine content was determined as given by the author.[2] Electronic absorption spectra was recorded on a Unicam SP 500 Spectrophotometer, using formamide solutions of complexes. The absorption bands are listed in Table I.

TABLE I

Visible absorption bands and their molar absorbance

No.	Formulæ	Position of absorption band		Molar absorbance	
		V_2	V_3	V_2	V_3
1	$[Co(NH_3)_6]_2$ $[Fe(CN)_6]$	525 mμ	480 mμ	10·10	5·80
2	$[Co(en)_3]_2$ $[Fe(CN)_6]$	535 mμ	482 mμ	10·05	6·00
3	$[Co(pn)_3]_2$ $[Fe(CN)_6]$	540 mμ	490 mμ	10·95	6·02

The conductivity measurements of 10^{-3} M. nitrobenzene solutions (at 25° C.) indicate the complex dissociating into 3 ions.[3] The formulæ of the complexes can thus be written as $[Co(NH_3)_6]_2$ $Fe(CN)_6$ and $[Co(en \text{ or } pn)_3]_2$ $Fe(CN)_6$.

Cobalt (II) ion in an octahedral field is known to possess three absorption bands in the visible spectrum. The main band of the spectrum is the V_2 band, the slight shoulder on the higher frequency side is V_3 band. V_1 lies in the infra-red, where it escapes detection.[4] These complexes under investigation also dissolve in formamide to give pale pink solutions, which exhibit a very sharp V_2 band in the vicinity of 535 mμ and another shoulder at 480 mμ (V_3). The pink colour of the solutions is due to very weak visible absorption of the complex (molar absorbance values in the range 0–10). These bands arise due to following transition:

(a) $^4Ti(F) \rightarrow {}^4T_2$ (V_1) in the infra red region.
(b) $^4T_1(F) \rightarrow {}^4A_2$ (V_2) at 530 mμ.
(c) $^4T_1(F) \rightarrow {}^4T_1(P)$ (V_3) at 480 mμ.

Dept. of Chemistry, (MISS) PADMAJA R. SHUKLA.
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CATALYTIC MAXIMA IN THE BROMINATION OF p-BROMOPHENOL

FROM a theoretical treatment of Bruner's results[1] on the iodine-catalysed bromination of benzene, Tsuruta and coworkers[2] concluded that, when the rate-determining step involves the interaction between one molecule of a 1 : 1 complex of benzene and bromine and m molecules of iodinebromide, a catalytic maximum in the velocity occurs when the ratio of total iodine to total bromine is equal to $m/(m+1)$, provided the total bromine concentration is kept constant. Gnanapragasam and Yeddanapalli, studying the bromination of phenol[3] and anisole,[4] observed that the maximum reaction velocity for the iodine-catalysed reaction occurs, when the ratio is $m/(m+2)$.

More significant results can be obtained by studying the occurrence of catalytic maxima under conditions, where the concentration of substrate and also the sum of the concentrations of free bromine and catalyst are kept constant. If the equilibrium constant for the formation of the complex involving n molecules of bromine and one molecule of substrate is K, and m molecules of the catalyst are involved in the rate-determining step, the velocity is given by :

$$V = kK \, [\text{Substrate}] [\text{Free bromine}]^n \times [\text{Catalyst}]^m$$

where k is the rate constant. The condition for maximum velocity is given by the ratio :

$$R = \frac{[\text{effective catalyst}]}{[\text{free bromine}]} = \frac{m}{n},$$

In the case of iodine-catalysed bromination, iodinebromide is considered to be the catalyst.[5,6] The very high equilibrium constant for the formation of iodinebromide in both, carbontetrachloride[7] and acetic acid,[6,8] permits the assumption that all the iodine is in the form of iodinebromide.

With sufficiently large bromine concentrations to prevent any dissociation of iodinebromide, the maximum velocity, in carbontetrachloride and acetic acid solvents, occurred when the ratio R was equal to one. Independently, m and n were found to be equal to one. The ratio of total iodine to total bromine at the maximum should be $m/(m+2n)$, which in this case was found to be equal to 0·33. An examination of the values of the two ratios at which maxima are observed, shows that two molecules of catalyst are formed from one molecule each of iodine and bromine, confirming that the effective catalyst is iodinebromide.

At constant bromine concentration, in acetic acid medium, increase in aluminium chloride concentration took the velocity through a maximum, suggesting that it is a complex of aluminium chloride and bromine that is the effective catalyst, as has already been suggested in literature.[9] Assuming a 1 : 1 complex between aluminium chloride and bromine, the maximum velocity should be observed when the ratio R is equal to m/n. Experimentally R is found to be equal to one. The ratio of aluminium chloride concentration to total bromine concentration, at the maximum velocity, must be equal to $m/(m+n)$ equal to 0·5. The experimentally observed value of 0·5 confirms the assumption made, that the effective catalyst is a 1 : 1 complex between bromine and aluminium chloride. Independent experiments have shown the orders to be one for each of the reactants.

This method gives good agreement between theory and observation. It permits the determination of the order with respect to the catalyst, provided the order with respect to bromine is known, or *vice versa*. Further, information can be obtained regarding the effective catalyst and its composition.

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OCCURRENCE OF ANORTHITE AND ANTIPERTHITIC BYTOWNITE FROM THE CHARNOCKITIC ROCKS OF KONDAPALLI

THE dykes and lenses of basic charnockitic character occur in considerable number in the hill ranges of Kondapalli, Krishna District (Andhra Pradesh), but those of ultrabasic variety are of very restricted occurrence. During the course of preliminary optical work on the minerals of these rock types, it was

recognized that the plagioclase feldspars are unusually calcic in composition. Plagioclase feldspars of calcic labradorite type or of more anorthitic varieties are either rare or unreported from the charnockitic terrains of the world including that of the type area near Madras, some 200 miles south of Kondapalli. The purpose of this note is to record, for the first time, the occurrence of so calcic a plagioclase as "anorthite" and of medium-calcic "bytownites" (some of them strangely being antiperthitic) in these Kondapalli rock types—features which are either unknown or most unusual for the charnockitic and granulite facies rocks from any part of the world.

The plagioclase feldspars from four rocks were separated and purified by using the isodynamic separator and centrifuging in tetrabromo-ethane ; the final purified concentrates were thoroughly washed with acetone. Table I shows the results obtained from partial chemical analyses of these purified samples ; the alkalies were determined by using the flame photometer, lime by the EDTA titration and total iron (as Fe_2O_3) with the spectrophotometer. The totals obtained for the plagioclase feldspars from calculation of the data (Table I) are considered to be a measure of the purity of the samples and accuracy of the analyses.

The An content (An/An + Ab) of the plagioclases from the ultrabasic charnockitic lens J 22 and dyke 472 is 92% (anorthite) and 89% (calcic bytownite) respectively. The Or molecule of the anorthite J 22 seems to be rather high (1·18% by weight). It is significant that the ultrabasic charnockites of Kondapalli always contain a small amount of plagioclase while those from the type area appear to be devoid of any plagioclase.[1,2] The An content of the plagioclase from the basic charnockitic lens 28 and dyke P 45 is 88% (calcic bytownite) and 81% (medium bytownite) respectively. Contrary to the general expectation, the plagioclase P 45 (An_{81}) is antiperthitic and the presence of K-feldspar exsolution blebs is confirmed by staining the thin section with sodium cobalti-nitrite ; the antiperthitic nature is also strikingly reflected in the high Or content (2·20%) of the plagioclase. Though antiperthites are reported from the plagioclase of basic charnockites of Madras,[1,3] they are commonly restricted to the oligoclase-andesine range and almost unknown in labradorite and bytownite.[4] Thus the antiperthitic bytownite P 45 is highly exceptional and the petrography of its host rock is already given by Grasty and Leelanandam.[5]

Diffractometer traces of these four Kondapalli plagioclases were taken using quartz as an internal standard and covering 2θ range 21 to 32° (Cu K_α). The values of $\Gamma = 2\theta$ (131) $+ 2\theta$ (220) $- 4\theta$ (1$\bar{3}$1) and B $= 2\theta$ (111) $- 2\theta$ (20$\bar{1}$) are employed to assess their structural state,[6] but the values of B are more suitable than those of Γ over the composition range An_{70-100}. Though not absolutely conclusive, the obtained data (Table I) suggest that these Kondapalli plagioclases possess transitional structural state.

TABLE I

	J 22	472	28	P 45
CaO	18·30	177·69	1·63	15·91
Na_2O	0·93	1·31	1·37	2·18
K_2O	0·20	0·07	0·06	0·37
Fe_2O_3	0·30	0·43	0·34	n.d.
Total *	99·82	99·23	99·40	99·57
Wt.% Or	1·18	0·41	0·35	2·20
Ab	7·88	11·16	11·66	18·53
An	90·93	88·42	87·99	79·27
$\dfrac{An}{An+Ab}$	92·02	88·79	88·29	81·05
B	0·746	0·754	0·735	0·776

J 22—ultrabasic lens, South of Hyder Banda.
472—ultrabasic dyke, hillock ¼ mile north of Kotta Ibrahimpatnam Village.
28—basic lens, hill ·472.
P 45—basic dyke. southern fringe of Balija Gutta ·707
* —Total refers to that which is obtained when the feldspar is calculated from the partial analysis.
B $= 2\theta$ (1$\bar{1}$1) $- 2\theta$ (20$\bar{1}$).

Geology Department,   C. LEELANANDAM.
Osmania University,
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'DHANRASITE' THE TIN GARNET

THE occurrence of tin about 6 km. north of Charkabandha (24° 40' N. × 48° 28' E.), in Gaya District, Bihar, was reported by Nag[1] in 1925. The chemical analysis made by Nag showed 52·50% tin in 'garnet-cassiterite rock'.

An examination in parts of the 385 m. (1264') ridge of the Dhanras hill in the Chakrabandha tin area revealed the presence of numerous garnet pockets occurring in the sericite-silli-manite-mica schists. The garnet-bearing pockets vary in length from one to five metres with a general thickness of less than a metre, concordant with the NNW-SSE trend of foliation of the mica schists. These pockets occur in a zone with a strike length of 240 m. and width of 2 m., extending in a general NW-SE direction, estimated to contain 770 tonnes of garnet.

Garnets varying in size from small grains to as large as an apple occur as porphyroblasts in the sericite-sillimanite-mica schists. The colour of the garnet varies from dark brown to deep red. It shows blue and green stains along the cracks and fissures. The specific gravity of two samples of garnet was found to be 3·88 and 3·97 respectively. It is of the pyrope-almandite type, as determined by X-ray powder diffraction. On spectrochemical analyses four samples of garnet showed 450 ppm., 2,000 ppm., 10,800 ppm., and over 20,000 ppm. tin respectively.

Under the microscope, ascicular crystals of sillimanite occur in radiating felted masses, folded and bent around garnet grains associated invariably with quartz showing 'augen' structures, in the sericite-sillimanite-mica schists. Quartz show inclusions of sillimanite. Garnets commonly show inclusions of quartz. Quartz invariably shows strain effect and felspar is usually sericitised. Biotite occasionally shows plenty of pleochroic haloes due to the presence of zircons. Chlorite, muscovite, hornblende, etc., also occur associated with the garnets.

The development of garnet increases towards the southern part of the Dhanras hill. Garnets appear to have developed after biotite at high temperature during thermal metamorphism. The rocks are characterised by retrograde metamorphism, causing extensive sericitisation and chloritisation. It is apparent that tin mineralisation is associated with the development of garnets. It appears that the element tin in garnet may be present in the silicate lattice possibly replacing iron. To the garnets containing appreciable tin is suggested the name 'DHANRASITE', after the hill in which they are found to occur.

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A NOTE ON THE MIDDLE TO UPPER MIOCENE PLANKTONIC FORAMINIFERA FROM ANDAMAN ISLANDS, INDIA*

THE Neogene planktonic foraminifera from Andaman Islands have drawn little attention of the earlier biostratigraphers. There are only stray mentions of their occurrence in published literature, although planktonic forminifera are in general very abundant in these rocks. The present note deals with the existence of Middle to Upper Miocene planktonic forminifera from the Interview Island (92° 39' 21"–92° 39' : 12° 46' 50"–12° 59' 40") Andaman. Twenty-eight species or subspecies of planktonic forminifera, majority of them being reported for the first time from the Indian subcontinent, have been identified from the samples collected along the east and west coast of the island from the location 92° 40' 52" : 12° 52' 20", 92° 41' 35" : 12° 49' 55" and 92° 42' 51" : 12° 50' 30". The samples were referred to the Round Silt and Chalk Formation (Chandra and Guha, 1963) by the field geologist.

The species identified from the above samples include : *Hastingerina siphonifera* (d'Orbigny), *Globigerina foliata* Bolli, *G. conglomerate* Schwager, *G. falconensis* Blow, *G. nepenthes* Todd., *Globoquadrina altispira altispira* (Cushman and Jarvis), *G. altispira globosa* Bolli, *G. dehiscens dehiscens* (Chapman, Parr and Collins), *G. venzuelana* (Hedberg), *Globigerinoides triloba triloba* (Reuss), *G. triloba immatura* Leroy, *G. triloba sacclifera* (Brady), *G. rubra* (d'Orbigny), *Sphœroidinella dehiscens subdehiscens* Blow, *Sphœroidinella seminulina grimsdalei* (Keijzer), *S. seminulina seminulina*

(Schwager), *Orbulina universa* (d'Orbigny), *O. bilobata* (d'Orbigny), *Globorotaloides* sp., *Globorotalia acostœnsis* Blow, *G. mayeri* Cushman, *G. menardii menrdii* (d'Orbigny), *G. minutissima* Bolli, *G. obesa* Bolli, *G. opina continuesa* Blow and *G. scitula scitula* (Brady).
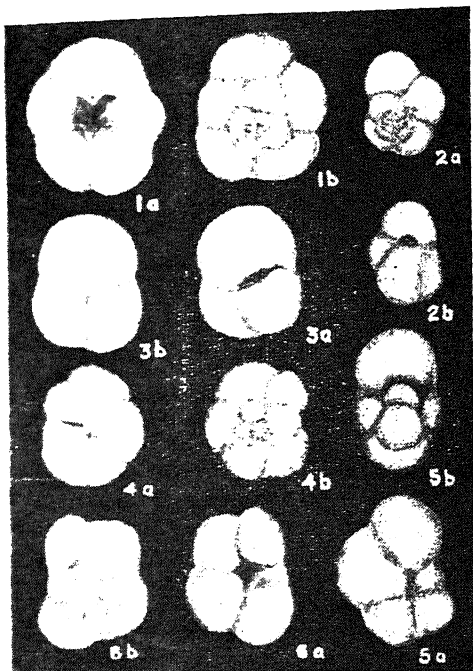
FIGS. 1-6. Fig. 1 *a-b. Globoquadrina altispira globosa* Bolli, × 46·5. (*a*) Umbilical view; (*b*) Spiral view. Fig. 2 *a-b. Globigerina nepenthes* Todd, × 46·5. (*a*) Spiral view; (*b*) Umbilical view. Fig. 3. *a-b. Sphæridinella dehiscens subdehiscens* Blow, × 42. (*a*) Umbilical view; (*b*) Spiral view. Fig. 4 *a-b. Globorotalia acostœnsis* Blow, × 31·5. (*a*) Umbilical view; (*b*) Spiral view. Fig. 5 *a-b. Hastigerina siphonifera* (d'Orbigny) (*a*), × 50 Side view; (*b*) Apertural view. Fig. 6. 6 *a-b. Sphæroidinella seminulina grimsdalei* (Keijzer), × 42. (*a*) Umbilical view; (*b*) Spiral view.

The planktonic species recorded in the samples have marked similarities to those described by Bolli (1957) from *G. mayeri, G. menardii* Zones, Lengua Formation, Trinidad and by Blow (1959) from *Globorotalia mayeri* zone (S.L.) and *Globorotalia menardii menardii/Globigerina nepenthes* zone Pozon Formation, Eastern Falcon, Venezuela. Bandy (1963) also recorded similar planktonic assemblage from the Middle to Upper Miocene rocks of Philippines.

Blow (1959) correlated the above-mentioned zones of Venezuela and Trinidad and assigned them a Middle to Upper Miocene (Vindobonian-Sarmatian) age. Recently, Bandy (1964), pointed out that the association of *Saphœroidinella*

dehiscens subdehiscens and *Globoquadrina altispira globosa* Bolli, is also indicative of Middle to Upper Miocene age.

In the light of above considerations, the author concludes that the fauna recorded from samples under reference could be assigned a Middle to Upper Miocene age.

The author is indebted to Sri. M. R. Ramachandra for providing the material, to Sri. D. K. Guha for guidance, to Sri. K. S. Soodan for making the sketches and to Sri. D. S. N. Raju for valuable suggestions.

Palæontology Laboratory,   P. KUMAR.
Oil and Natural Gas Commission,
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C[14] DATE OF A FOSSIL ELEPHANT TUSK FROM SIRSA VALLEY, HIMACHAL PRADESH

THE Sirsa-Jhajra drainage in the submontane region between Nalagarh and Kalka in Himachal Pradesh (formerly in East Punbjab) is well known for its Upper Shivalik fossiliferous beds and the implementiferous pleistocene river terraces.[1] The Shivalik beds are exposed on the left bank of the Sirsa which flows in a NNW direction. On its right bank are seen three implementiferous terraces 70, 40 and 10 feet above the water-level of the stream. So far no stone age implement has been found from the left bank nor was there any report recording the discovery of vertebrate fossils from the terraces on the right. Therefore, the discovery of a fossil elephant tusk from one of these terraces, which forms the subject-matter of this note, is worth recording.

The fossil was found during the author's field-work in this area in February 1966 at a place called Har Raipur. This village is nearly 19 miles from Pinjaur. A road from Pinjaur to Nalagarh runs along the right bank of the Sirsa mostly over the lowest terrace. At Har Raipur it passes through a deep cutting of the next higher terrace leaving a vertical cliff section, some 35 feet high. The top of this terrace is littered with broken pieces of pottery and other

related antiquities of the protohistoric to early-historic period with occasional appearance of the prehistoric stone artifacts.

The road-cutting section which contained the fossil tusk shows from bottom upwards :

(1) a layer of gravel (approx. 2 ft.) followed by,

(2) a layer of white silty deposit (3 to 5 ft.) capped by,

(3) another layer of gravel (5 to 7 ft.).

(4) A thick deposit of white calcareous sand (7 to 10 ft.) covers the second gravel layer which is underlain by,

(5) a huge deposit of gravels and boulders of about 15 feet in thickness seen at the top of the section (Fig. 1).
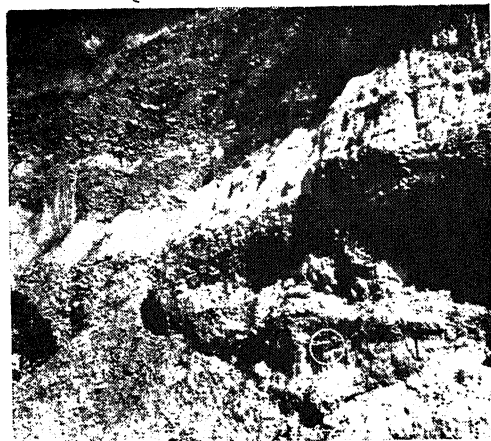
FIG. 1

The fossil was extracted out from the junction of strata (2) and (3). It was lying embedded in the silt with the cover of gravels of the next stratum immediately above (Fig. 1 white circle). Thus it will be seen that the fossil was found about five feet above the road level and nearly 30 ft. below the surface of the terrace. Its *in situ* position is indisputable as it was dug out from a firmly cemented matrix and from considerable depth. The specimen constituted the pointed tip of the tusk. It measures 18 inches in length and about 4 inches in diameter at its thickest. It was partially mineralised and brittle.

With the hope that this fossil might throw some light over the age of the implementiferous terraces, it was sent for analysis to the Radio-carbon Laboratory of the Tata Institute of Fundamental Research, Bombay. Its C[14] report is as follows :

Har Raipur, Panjab   Date
TF-611 ELEPHANT TUSK   4070 ± 95 (4190 ± 95)

"Tusk of an elephant from Har Raipur F-1 from Stone Age terrace. Sample submitted by G. C. Mohapatra. Comment : inorganic fraction of bone alone could be dated ; contamination probability is high. Organic fraction recovered was not sufficient."

The author wishes to thank Shri D. P. Agrawal, Tata Institute of Fundamental Research, for the laboratory analysis of the specimen.

Dept. of Ancient Indian   G. C. MOHAPATRA.
History and Culture,
Punjab University,
Chandigarh, *December 14, 1966.*

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DEGRADATION OF FILTER-PAPER AND CERTAIN VEGETABLE FOOD-STUFFS BY *PESTALOTIOPSIS WESTERDIJKII* ENZYME

MANY fungi, bacteria, and actinomycetes possess cellulolytic properties of which fungi are more promising in the production of cellulase and related enzymes.[1-6]

Isolation and properties of extracellular enzyme from *Pestalotiopsis westerdijkii* was studied in some detail by the author.[7] The fungus was grown on coconut flour—solka-floc base for 10 days and the enzyme was extracted with distilled water, concentrated with ammonium sulphate and partially purified by gel-filtration. The enzyme showed a wide range of substrate specificity. Treatment of deoiled coconut flour with this enzyme not only improved the protein extractability but also reduced its crude fibre content to about half.[8]

When pieces of Whatman No. 1 filter-paper were incubated with 4 ml. of enzyme or enzyme *plus* water at pH 6·0 and 40° C. for 48 hr. a weight loss of 43% (Table I) on dry basis was noticed at the highest concentration and the paper was completely pulped (Fig. 1). Gradual

TABLE I

Break-down of filter-paper by P. westerdijkii enzyme at various concentrations

Dilution factor	Weight loss (%)
0 (Original)	43
2	19
4	7
8	5
16	4
32	3

decrease in weight loss corresponding to the decrease in concentration of the enzyme is noteworthy.

Incubation of shredded coconut, whole green-bean, piece of cabbage and thin slices of potato, cucumber and carrot with 6 ml. of enzyme at its optimum pH and temperature for 48 hr. resulted in complete degradation of potato, cucumber and carrot except for the outer peels. Shredded coconut went into solution within 12 hr. of incubation (Fig. 2). Only slight degradation noticed in the case of green-bean and cabbage can be attributed to the presence of outer, waxy cuticle layer which acts as a barrier to the enzyme's reaching the cell parts. Toyama[9] observed similar effects with other fungal enzymes.
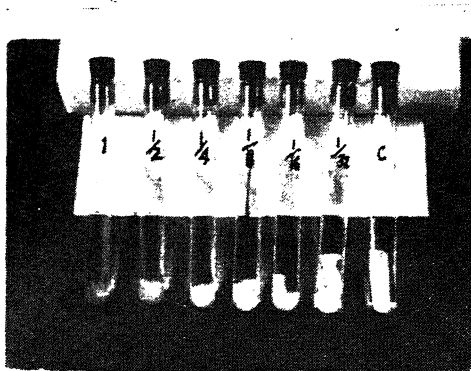
FIG. 1. Pieces of Whatman No. 1. filter-paper were incubated with varying concentrations of enzyme except for the tube at right wihch contained no enzyme. The tube at left labelled 1. contained 4 ml. of the enzyme. Dilutions of enzyme in the other tubes were as indicatebd.
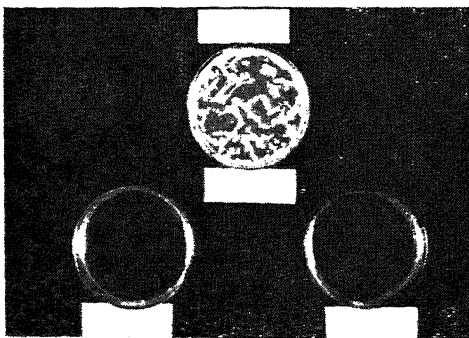
FIG. 2. Shredded coconut Top : No enzyme. Bottom left : 12 hr. incubation with 6 ml. enzyme. Bottom right : 48 hr. incubation with 6 ml. enzyme.

The above results are the first conclusive evidences of *P. westerdijkii* enzyme to degrade structural and other polysaccharides of plant origin.

Dept. of Biochemistry   A. CHANDRASEKARAN.*
and Nutrition,
Virginia Polytechnic Institute,
The Landgrant University,
Blacksburg, Virginia, U.S.A.,
December 20, 1966.

* Present address : Discipline of Microbiology, C.F.T.R.I., Mysore-2 (India).

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ESTABLISHMENT OF *APHELINUS MALI* (HALDEMAN) AT SHILLONG, ASSAM

THE woolly aphid *Eriosoma lanigerum* (Hausman) is a serious pest of apples and is widely distributed in many parts of the world. In India it occurs in the hill districts of Himachal Pradesh, Punjab and Uttar Pradesh and also in the Nilgiris in the south. Apples are also grown on a small scale in the Government Fruit Garden, Shillong (1,570 metres a.s.l.): A very severe infestation by *E. lanigerum* was observed here until 1963. The pest appeared in small numbers in February or March but gradually built up its population and became very severe during August, September and October.

Successful biological control of the woolly aphid has been achieved in several countries by the introduction of the Aphelinid parasite, *Aphelinus mali* (Haldeman). In India this has occurred in the Kulu Valley (Himachal Pradesh) and at Coonoor (Nilgiris) (Rahman and Wahid Khan, 1941 ;[1] Cherian, 1942).[2]

In an attempt to control the woolly aphid at Shillong *A. mali* was introduced from Coonoor and Kulu in 1963 and 1964. 100 adult parasites recevied from Coonoor in April 1963 were

released on an infested sleeved branch. Within three weeks mummified (parasitised) woolly aphids were observed in this sleeve. Emerging adults parasitised the remaining woolly aphids present on the sleeved branch. The duration of the immature stages of the parasite was about 30 days. In June 300 parasites were received from Coonoor; of these 100 were released on a sleeved branch, and the rest directly over other infested branches. Observations made in July indicated that the parasites released directly had also attacked the pest; however, their activity was found to be very limited. In July about 300 adults from the sleeves were released on other sleeved branches. Heavy parasitism was very soon noticed. The infestation of the pest in August, September and October was considerably less than in the corresponding months of the previous years. In October 3,000 parasites were received from Coonoor and Kulu; 1,000 were released on 8 sleeved branches, and the rest directly in the field. Mummified aphids were observed in large numbers until December, and effective control of the pest was obtained. However, in 1964 the woolly aphid reappeared. It was thought that the parasite had failed to build up its population following the severe cold in January 1964. Therefore, further releases of *A. mali*, received from Kulu, were made; 600 adults on sleeved branches in August, September and October 1964. Following these releases the parasite has become well established and has very effectively checked the pest. Parsitised woolly aphids are now quite common on the apple trees and it has not been necessary to make any further releases of *A. mali*, or to take any chemical control measures during the last two years.

Commonwealth Institute of   M. J. CHACKO.
   Biological Control,
Indian Station,
Bangalore-6, India, *January* 8, 1967.

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ON FERTILE PLANTS OF *LUNULARIA CRUCIATA* IN INDIA

So far, only the vegetative plants of *Lunularia cruciata* (L.) Dum. bearing characteristic semilunate gemma cups have been reported from India. The fertile specimens of this plant are usually extremely rare even in other continents as well.[1] In a plant collection trip to various localities in South India during the last week of December 1965, a number of male plants of *L. cruciata* were collected by me and Dr. Ram Udar in the damp narrow gorge in Government Botanical Garden, Ootacamund.

The nature of the dorsal epidermal cells and pigmentation of the ventral surface of the thallus in *Lunularia* were regarded by Herzog[2] to be of specific significance. Accordingly plants showing greatly thickened dorsal epidermal cells and dark purple colour of the ventral surface of the thallus were raised to a new species *L. thaxteri*[2] while the rest remain under *L. cruciata*. Recently, observation of the plants under cultivation[3] have shown that these distinctive features are not stable and such plants have been regarded to represent 'forma *thaxteri* (Evans and Herzog) Hassel de Menendez.'

Recently Campbell[1] has shown that plants in New Zealand show three types of dorsal epidermal cells depending on conditions of growth : (1) cells with thin walls; (2) cells with prominent trigones and (3) cells with uniformly thickened walls. Thalli with uniformly thick-walled epidermal cells grow under high light intensity, low temperature and high humidity. New thalli arising from such plants under lesser light intensity show the characteristic trigones of the epidermal cells, but those arising on plants transferred to green-houses have cells with thin walls. It is therefore certain that these variations are merely ecological and not of any taxonomic significance.

In South India plants with thin-walled epidermal cells (Fig. 5) are very common in shaded and highly humid conditions and those with trigones (Fig. 6) in humid but exposed habitats. Thalli showing uniformly thickened epidermal cells have not yet been discovered.

Only male plants are represented in the collection. It is quite possible that the female plants may also be occurring in the same locality but developing to their characteristic shape only later in the season.

The present report from South India is the first record of sexual plants of this taxon in the bryoflora of India.

The plants (Figs. 1, 2) are green in colour with purplish margins, delicate, dichotomously branched and approximately up to 3 or 4 cm. long and 0·8 cm. broad. Younger thalli innovate from the tips of the older ones. Epidermal cells are thick-walled (Fig. 6) with distinct trigones. The air chambers are filled with simple, branched filaments and open externally through simple, elevated pores. The

ventral scales are in a single row on each side of midrib. They are delicate, hyaline and have a broad rotundate appendage. The dorsal semilunate gemma cups are very common.
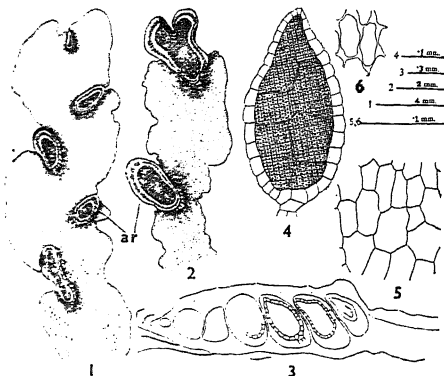
FIGS. 1–6. Fig. 1. Thallus showing alternate antheridial receptacles (*ar*). Fig. 2 Thallus showing bilobed antheridial receptacle. Fig. 3. Longitudinal section of the thallus through an antheridial receptacle. Fig. 4. Antheridium in L.S. (semi-diagrammatic). Fig 5. Thin-walled epidermal cells. Fig. 6. Thick-walled epidermal cells with distinct trigones.

The male receptacles (Figs. 1, 2 : *ar*) are sessile, slightly elevated, terminal at the point of dichotomy, disciform and occasionally bilobed (Fig. 2), up to 3 mm. long, surrounded by a membranous cup-like sheath with slightly dentate margin. In mature male thalli (Fig. 1) they appear lateral by suppression of growth in the branches bearing them and usually regularly alternate in position. The antheridia (Fig. 4) are pear-shaped with a sterile jacket one cell layer thick, and a stalk two cells wide. Each antheridium remains embedded in the receptacular tissue in an antheridial chamber (Fig. 3).

The present work has been completed during the tenure of a Junior Research Fellowship in the project "Studies on the Hepaticæ of South India" sponsored by the Council of Scientific and Industrial Research, Government of India, under Dr. Ram Udar to whom the author is grateful for the valuable guidance.

Department of Botany,   S. C. SRIVASTAVA.
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CULTURAL BEHAVIOUR OF *SCLEROTIUM ROLFSII* SACC. AT DIFFERENT pH LEVELS WITH AND WITHOUT THIAMINE SUPPLEMENTATION

WHILE making cultural studies of *Sclerotium rolfsii* on Asthana and Hawker's medium-A, it was observed that mycelial growth was optimum and sclerotial formation good at pH 5·5. At the other pH levels tried, *viz.*, 2·7, 3·5, 4·4, 6·6, 7·3 and 8·0, mycelial growth was found to be retarded and no sclerotia were formed unless thiamine was supplemented. The intriguing behaviour of this fungus to form sclerotia at a particular pH, even in the absence of thiamine, led to further experimentation. The fungus was, therefore, grown on media in which the hydrogen-ion concentration has been adjusted to pH 4·5, 5·0, 5·3, 5·5, 5·7, 6·0 and 6·5. Two sets of four replicates were maintained at each of these pH levels. One of the sets was without thiamine while the other contained thiamine hydrochloride at the rate of 1 p.p.m.

Comparison of results between the two sets showed that exclusion of thiamine from the medium decreases the dry weight of the fungus, at corresponding pH levels (Fig. 1). On the
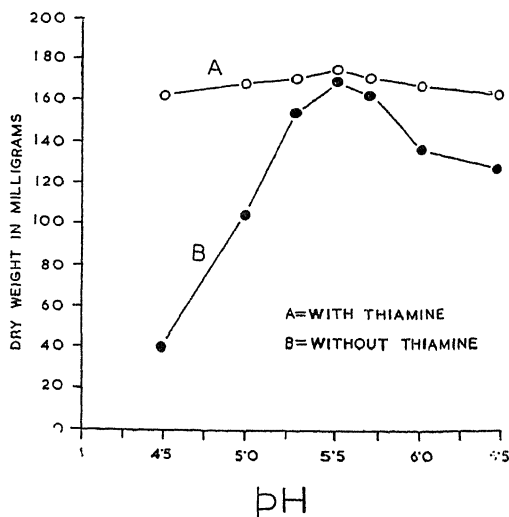
FIG. 1. Growth of *Sclerotium rolfsii* at different pH levels with and without thiamine supplementation.

thiamine-deficient medium, mature sclerotia were formed only at pH 5·5. A few immature sclerotial initials were observed at pH 5·3, but at the other pH levels tested, even sclerotial initiation did not take place. Sclerotial production on the thiamine-supplemented medium was, on the other hand, good at all the pH levels. In the thiamine-deficient medium, pyruvic acid

could be detected by the iodoform reaction[6] after the fifth day of growth, at all pH levels, but in no case did pyruvic acid accumulate in the thiamine-supplemented cultures.

S. rolfsii has been reported by previous workers to require very little quantities of thiamine for satisfactory growth and sclerotial production.[3,4,7] According to some authors[1] it seems possible that those fungi, having very little requirements of thiamine, are able to synthesize this vitamin once growth has been initiated. In another case it was reported[5] that the test fungus (*Sordaria fimicola*), if cultured at pH 4 or above, was self-sufficient for thiamine but at lower pH values, thiamine deficiency became manifest. The observations in the present case clearly demonstrated, however, that thiamine deficiency in *S. rolfsii* is absolute and not governed by the pH of the culture medium; and the blockage of glucose utilization at the pyruvic acid stage in the thiamineless medium showed that this fungus is unable to manufacture this vitamin, although its requirements are very little. The small amounts of mycelial growth present in the thiamine-deficient medium was probably because this vitamin was introduced as contamination along with the sclerotium that was used as inoculum to seed each flask.

Although vegetative growth and sclerotial production need not be affected similarly by the same cultural factors,[2,4,9] sclerotia are nothing but hyphal aggregations.[8] Sclerotial formation in *S. rolfsii* has been reported to be regulated by the hyphæ growing at the periphery of the colony; the initiation of sclerotia having been observed if the radial growth of the colony is checked at the periphery in some way.[9] In the present investigation, due to faster mycelial growth rate at the favoured pH levels of 5·5 and 5·3, the periphery of the mycelial mats could quickly reach the sides of the conical flasks before a complete stoppage of growth could occur due to the incomplete utilization of glucose in the thiamineless medium. The sclerotia were, therefore, initiated because the sides of the flasks 'checked' the radial growth of the mats. At the unfavourable pH levels, growth, in the absence of thiamine, came to a complete standstill as a result of the non-availability of the Kreb's cycle energy due to the blockage of pyruvic acid utilization. It may be concluded that other conditions remaining the same, the thiamine requirements of *S. rolfsii* at favourable pH levels are less, as compared to the unfavourable pH levels, for the same amount of growth.

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Government Science College,
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SLIME BODIES IN THE COMPANION CELLS OF *CORDIA SEBESTENA* L.

MANY phloem researchers tend to think that the densely stained substance in the companion cells might be similar to the sieve tube slime. But so far this fact has been conclusively proved only in three plants, *viz.*, *Vitis vinifera*, *Pyrus malus* and *Robinia pseudoacacia* by the presence of discrete slime bodies in the young developing companion cells.[1] During the course of our investigation on the phloem of dicotyledons, we have observed slime bodies in the young developing companion cells of the petiole of *Cordia sebestena* L.

Slime has been observed in the sieve tube element and the companion cell. The development of the slime in the sieve tube element occurs earlier than that in the companion cell. The development of the slime in the companion cell generally occurs after the slime bodies have diffused and mixed up with the contents of the sieve tube element. Figure 1 illustrates a developing sieve tube element and a companion cell. The protoplast of the sieve tube element immediately after its differentiation from the sieve tube mother cell differs little in density from the companion cell protoplast.

A number of slime bodies appears first in the sieve tube element. They may be rod, spheroid or spindle-shaped. They appear first in the parietal cytoplasm. But in certain cases they are in the region where vacuole was present in

the younger sieve tube element (Fig. 2). No tonoplast is distinguished. Figures 3 and 4 show the slime bodies in the companion cell. They are oval, rod or spindle-shaped. Some of them are darkly stained and bigger in size compared to the slime bodies of the sieve tube elements. Such bodies appear to be normally found in vacuole-like cavities. Certain cavities show membrane-like structure around them. The other lightly stained slime bodies which are similar to those found in the cytoplasm of the sieve tube element, are also present in the cytoplasm of the companion cell. Eventually, after the dispersal of these bodies throughout the cavity of the companion cell, a number of vacuole-like spaces is observed in the cytoplasm (Fig. 5).

The contents of the companion cell may be present at different densities at various regions. The companion cell nucleus persists at maturity.

With this observation, the number of species whose companion cells are reported to have slime bodies becomes four. The presence of slime in the companion cell indicates its close functional relationship with the sieve tube element. According to Tamulevich and Evert (1966)[2] the slime is the only substance of cytoplasmic origin to become mixed with the vacuolar contents in the sieve tube element. Some workers[3] believe that the central cavity has a mixture of cytoplasmic and vacuolar contents, including slime. The diffusion of slime with the cytoplasm in the companion cell indicates varying morphogenetic features of the slime in the sieve tube element and companion cell.

One of us (R. J.) is thankful to C.S.I.R. for the award of a Junior Research Fellowship.

Department of Botany,   J. J. SHAH.
Sardar Patel University,   RAJU JACOB.
Vallabh Vidyanagar,
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IGS. 1-5. Fig. 1. A developing sieve tube element a companion cell. Fig. 2. A differentiating sieve e element with slime bodies (*s*) at the vacuole-like gion. Figs. 3-4. Slime bodies in the companion cells. arkly stained bodies (*d*) appear to be in the vacuole-like hile the lightly stained ones (*l*) appear to be cavities, n the cytoplasm. Fig. 5. A mature companion cell.

PERMANENT WHOLE MOUNTS OF *VOLVOX*

THE preparation of whole mounts of botanical materials is indispensable for revealing features that are not otherwise clear in ordinary microtome sections. Known methods for *Volvox* colonies—*e.g.*, Johansen (1940),[1] Sass (1958),[2]— are time-consuming. We found the following technique to be quite satisfactory for *Volvox* colonies fixed and stored in 4% formalin, and permanent slides could be prepared in about 30 minutes :

1. To a clean slide add a few colonies of *Volvox* (use a dropper) and remove (with a fine forceps) all extraneous particles, dead insects, etc., under a binocular microscope.

2. Use a brush to add sufficient Aniline Blue (0·5% in Lactophenol) and disturb the material.

FIG. 1. *Volvox* sp. : Whole mount of reproductive colonies, × 80.

3. Warm the slide gently and do not overheat; after a few seconds most of the *Volvox* colonies stick firmly to the slide.

4. Remove the peripheral colonies with a clean piece of cloth.

5. Dehydrate the slides in 90% absolute ethanol for ten minutes each; the intensity of stain can be regulated in 90% alcohol.

6. Mount in euparal or thin canada balsam; dry in an electric oven for a day.

These preparations have proved to be quite satisfactory for class use and there was no clumping of the colonies during staining or later (*see* Fig. 1). This technique can also be tried for other genera of the Volvocales. The reagents employed are cheap and easily obtainable by school and college laboratories.

Dept. of Botany,   V. P. SINGH.
University of Delhi,   M. R. VIJAYARAGHAVAN.
Delhi-7, *November* 22, 1966.

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REVIEWS AND NOTICES OF BOOKS

Dr. D. N. Wadia Commemorative Volume. (Mining, Geological and Metallurgical Institute of India), 1965. Pp. xxiii + 834. Price Rs. 35·00.

This book has been brought out as a special volume to honour Dr. D. N. Wadia by The Mining, Geological and Metallurgical Institute of India.

The volume contains 59 papers, most of which present original contributions, besides many felicitations and tributes to Professor Wadia. The papers represent contributions from 72 authors drawn from many parts of the globe including Australia, Canada, India, Italy, Japan, Pakistan, Spain, U.K., U.S.A. and the USSR.

The titles of a few papers of special interest are as follows : Radiometric Dating and its Limitations with Special Reference to the Archaean Rocks of India—A Review ; Determination of Hydrologic and Physical Properties of Volcanic Rocks by Laboratory Methods ; Morphological Studies of Some Indian Meteorites ; The Unavoidable Osteodontokeratic Culture ; Injected Granite Sheets of the Rongbuk Valley and the North Face of Mount Everest ; The Khoja-Mumyn, Tanapchi and Khoja-Sartis Domes in Tajikistan ; Natural Gas Geology of Japan ; The Geochemistry of Arsenic, Keno Hill-Galena Hill Area, Yukon, Canada ; Electro-winning and Refining of Certain Metals in Japan.   C. V. R.

Practical Hints on Absorption Spectrometry. By J. R. Edisbury. (Hilger and Watts Ltd., 98, St. Pancras Way, London, N.W. 1), 1966. Pp. xii— 266. Price 50 sh.

An absorption spectrometer nowadays, with all its electronic gadgetry, is a formidable box of tricks. How to get the best out of it in consistently reliable absorption spectra poses a problem for every analytical laboratory of any size. Dr. Edisbury, in this book, has carefully dealt with all the principal makes of absorption spectrometers for the visible and ultra-violet regions of the spectrum. This book is not concerned with the infra-red region.

The major titles of the chapters contained in this book are as follows : First Principles ; Definitions : Units and Notation ; General Working Instructions ; Photographic Instruments : General Working Instructions :

Visual Instruments ; General Working Instructions : Photoelectric Spectrometers ; Light Sources ; Photo-Detectors ; Absorption Cells or Cuvettes ; Solvents ; Preventive Maintenance ; Stray Light ; Differential and Additive Absorption Spectrometry ; Atomic Absorption : A Brief Note ; Links with Sanity ; Collaborative Tests ; The Quest for Accuracy and Precision ; The Control Chart as a Prophylactic in Absorption Spectrometry, or a Child's Guide to Statistical Analysis ; Presentation of Results.   C. V. R.

Survey of Progress in Chemistry (Vol. 3). Edited by Arthur F. Scott. (Academic Press, New York and London), 1966. Pp. xii + 292. Price $ 7.95.

Volume 3 of this well-known series has been dealt with in five sections : 1. Photosynthesis, by J. A. Bassham ; 2. Flame Chemistry, by R. M. Fristrom ; 3. Kinetic Isotope Effects, by W. H. Saunders, Jr. ; 4. Asymmetric Reduction, by James D. Morrison and 5. Stereoregular Polymers, by Marvin H. Lehr.

This book will assist the college teacher and the graduate student to acquire some understanding of new developments in chemistry without having to struggle through the original research papers written for the specialist in the field.   C. V. R.

Agricultural Microbiology. By G. Rangaswami. (Asia Publishing House, Bombay), 1966. Pp. xiii + 413. Price Rs. 25·00.

This book is a study of the important aspects of Agricultural Microbiology and aims to enable a basic understanding of the pivotal role played by micro-organisms in life processes on earth with particular reference to Agriculture.

The origin and growth of micro-organisms, the methods of their study, classification, their forms, structure and functions, their biochemical activities and their genetics have been discussed in great detail. The role and functions of micro-organisms in soil processes and other aspects of soil microbiology have been dealt with. The chapter on Pathogenic Micro-organisms presents the fundamentals of Plant Pathology and discusses the major groups of micro-organisms that cause plant diseases. The beneficial and harmful aspects of microbial activity in the food and dairy industry, and the

characteristics of various human and animal pathogens are explained. Finally, dealing with the varied roles of micro-organisms, the author brings out their industrial and commercial importance.

This book will be found useful by students of Agriculture, and a selected bibliography appended at the end of each chapter will help to guide the reader in planning a more detailed study of the subject. C. V. R.

Nutrition : A Comprehensive Treatise (Vol. III *of Nutritional Status : Assessment and Application*). Edited by George H. Beaton and Earle W. McHenry. (Academic Press, New York and London), 1966. Pp. xvii + 349. Price $ 15.00.

This comprehensive three-volume treatise presents an up-to-date review of human nutrition. Each topic is treated in depth and is fully documented. Special emphasis is placed on recent advances.

The first part of Volume III is devoted to a review of the methods of appraisal of nutritional status—dietary, biochemical, and clinical. These discussions are complemented by a critical survey of the present knowledge of food composition. The contributors also consider food additives, a topic that has assumed increased significance in the developed countries. The remaining chapters discuss the application of basic knowledge to particular areas of nutrition, such as maternal and infant nutrition, childhood nutrition, geriatric nutrition, and therapeutic diets.

Research workers, university teachers, and graduate students in the fields of nutrition, biochemistry, and physiology will find this treatise of great value. C. V. R.

The Excitement and Fascination of Sciences (*A Collection of Autobiographical and Philosophical Essays*). (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1965. Pp. x + 566. Price : Clothbound $ 5.00 (U.S.A.); $ 5.50 (elsewhere). Paperback : $ 1.95 (U.S.A.); $ 2.45 (elsewhere).

The scope of this book is indicated by the titles of the chapters contained therein : My Life Among the Axons, by George H. Bishop ; Problems and Prospects of a Pharmacological Career in India ; Notes on a Half-Century of Research, Teaching, and Administration ; Impressions of an Organic Chemist in Biochemistry ; Pharmacology during the Past Sixty Years ; Fifty Years of Physiology in

America—A Letter to the Editor ; A Physiologist Reminisces ; Born Fifty Years Too Soon ; Fifty Years "Synthetiker" in the Service of Biochemistry ; The Pharmacologists of Edinburgh ; The Organization of Science ; A Look at an Old But Still Current Problem ; Fifty Years of Physical Chemistry in Berkeley ; The Heat Production of Muscle and Nerve ; Trends in Physiology as Seen from South America ; Chemist, Biochemist, and Seeker ; Thirty Years of Atomic Chemistry ; The Increasing Responsibility of the Physiological Sciences ; Reflections on the Study of Physiology ; To the Physiologically Inclined ; My Early Experiences in the Study of Foods and Nutrition ; Physiology and Medicine : A Transition Period ; Biochemists, Biologists, and William of Occam ; Fifty Years of Physical Chemistry in the California Institute of Technology, by Linus C. Pauling ; Forty-Five Years of Biochemistry ; Sir Edward Mellanby, G.B.E., K.C.B., M.D., F.R.C.P., F.R.S. (1884–1955). The Man, Research Worker, and Statesman, by B. S. Platt ; Outlines of a Pharmacological Career ; Pharmacology in a Changing World ; Why An Annual Review of Pharmacology ; Lost in the Twentieth Century ; Fifty Years of Chemical Kineticists ; Fifty-five Years of Union Between Biochemistry and Physiology ; Fifty Years of Biochemistry in Germany ; Prefatory Chapter, by Otto Warburg ; Physiology from 1900-1920 ; Incidents, Accidents, and Advances. C. V. R.

Annual Review of Plant Physiology (Vol. 17). Edited by Leonard Machlis. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1966. Pp. vii + 525. Price $ 8.50. (U.S.A.) and $ 9.00. (elsewhere).

Volume 17 of this well-known series contains the following articles : Synchronous Cultures of Algae, by Hiroshi Tamiya ; Golgi Apparatus and Plant Secretion, by Hilton H. Mollenhauer and D. James Morre ; Role of Mineral Elements with Emphasis on the Univalent Cations, by Harold J. Evans and George J. Sorger ; Mineral Nutrition of Plants, by E. G. Bollard and G. W. Butler ; Seed Proteins, by Aaron M. Altschul, Lawrence Y. Yatsu, Robert L. Ory, and E. Mark Engleman ; Physical and Chemical Properties of Plant Viruses, by Robert Haselkorn ; Biological Nitrogen Fixation, by R. H. Burris ; Partial Reactions of Photosynthesis and Photoreduction, by Norman I. Bishop ; Cyclitols in Plants : Biochemistry and Physiology, by Laurens Anderson and Karl E. Wolter ; Lignins, by Stewart A. Brown ; Plant-Water Relations : Some Physical Aspects, by J. R. Philip ; Plant

Antitranspirants, by J. Gale and Robert M. Hagan; Translocation of Growth Regulators, by C. C. McCready; Abscission and Its Control, by Harry R. Carns; The Physiology of Root Growth, by H. E. Street; The Regulation of Cell Division, by Herbert Stern; Geotropism, by Malcolm B. Wilkins; Chemistry of Naturally-Occurring Growth-Regulating Substances, by E. M. Shantz; Synchronized Dividing Algae, by A. Pirson and H. Lorenzen; Postharvest Physiology of Fruits, by Elmer Hansen.

C. V. R.

Networks and Systems. By Peter H. O'N Roe. Addison-Wesley Publishing Co., Inc., 10–13, Chitty Street, London W. 1), 1966. Pp. 336. Price $ 12.50.

The book of interest to students of electrical engineering is concerned with the analysis of physical systems which can be described by linear algebraic and differential equations. The treatment adopted deviates from the conventional courses on network theory. It indicates a unified discipline of physical system theory, without resorting to analogies. The first three chapters are devoted to the basic concepts of network theory. The fourth chapter deals with solution of large networks through subnetworks. The fifth chapter deals with state equations for electrical networks and includes analytical, numerical, and analog techniques for their solution. The last chapter deals with applications of concepts developed to mechanical, hydraulic, and mixed systems. Essential mathematical background for understanding the text is contained in appendices on matrix algebra, Laplace transforms, Fourier series, etc.

A. S. G.

Stoichiometry. By L. K. Nash. (Addison-Wesley Publishing Co., Inc., 10–15, Chitty Street, London W. 1), 1966. Pp. 182. Price : $ 2.95 (Paperbound); $ 3.95 (Hardbound).

The well-known laws of numerical proportions of elements in chemical combinations are obtained from experimental data on macroscopic systems. How these data lead us to secure knowledge of the chemical microcosm, is the chief aim of the author in writing this book. Fundamental experiments are described and the logic of arguments leading to stoichiometric calculations is stressed in the treatment. The book, in short, deals with atomic weights,

molecular formulas, and microcosmic magnitudes.

A. S. G.

Fuel Calorimetry. By B. Pugh. (Butterworth and Co., Ltd., 88, Kingsway, London W.C. 2), 1966. Pp. 186. Price 28 *sh.*

The basic principles of fuel calorimetry are clearly explained in this little book which will serve as a supplementary text for students undergoing courses in Fuel Technology, Fuel Utilization, Boiler House Practice and Industrial Chemistry. The contents include Historical background of fuel Calorimetry, Calorific values, Calorimetry techniques, Modern bomb calorimeters, Gas and Liquid fuel calorimeters, Recording and Indicating calorimeters.

A. S. G.

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Science—Since 1500—A Short History of Mathematics, Physics, Chemistry, Biology. By H. T. Pledge. (H.M.S. Office, Atlantic House, Holborn Viaduct, London E.C. 1), 1966. Pp. 357. Price 18 *sh.* 0 *d.* Clothbound.

Elements of Probability Theory. By J. Bass. (Academic Press, New York), 1966. Pp. xiv + 249. Price $ 9.75.

The Analysis of Physical Measurements. By Pugh Winslow. (Addison-Wesley Publishing Co., Reading, Mass.), 1966. Pp. xiv+246. Price $ 4.75.

Networks and Systems. By Peter H. O'N Roe. (Addison Wesley Publishing Co., Reading Mass.) 1966. Pp. xiii + 336. Price $ 12.50.

Selected Papers on the Transfer of Radiation. Edited by D. H. Menzel. (Dover Publications, New York-14), 1966. Pp: iv + 269: Price $ 3.0.

Great Ideas in Information Theory, Language and Cybernetics. By Jagjit Singh. (Dover Publications, New York-14), 1966. Pp. ix + 338. Price $ 2.00.

The Geological Society of America Memoir 99, Part I—Geology of the Alaska Peninsula, Island Arc and Continental Margin (with Maps). By C. A. Burk. (Geological Society of America, 231, East 46th Street, New York 10017), 1966, Pp. ix + 250. Price $ 20.00.

Salinity and Aridity—New Approaches to Old Problems. Edited by Hugo Hoyko. (Dr. W. Junk, Publisher, 13, van Stolkweg, The Hague, The Netherlands), 1966. Pp. viii + 408. Price Dutch guilders 60 ; U.S. $ 16.65.

SUPERIOR RADIORESISTANCE OF POLYPLOIDS—A TOOL FOR THE PREFERENTIAL ELIMINATION OF DIPLOID CELLS IN A COLCHICINE-INDUCED MIXOPLOID TISSUE

E. A. SIDDIQ AND M. S. SWAMINATHAN

Division of Genetics, Indian Agricultural Research Institute, New Delhi

INTRASOMATIC selection in favour of diploid cells in colchicine-induced mixoploid shoot apices presents difficulties in the artificial induction of polyploidy in *Zea mays*. Lewis[4] suggested that the superior radio-resistance of polyploid cells can be exploited for the selective elimination of diploid tissue in colchicine-induced diploid-polyploid chimera. The present study was undertaken to standardise a suitable colchicine-*cum*-irradiation treatment which can be used for enabling the preferential survival of tetraploid cells in mixoploid shoot meristems of *Zea mays*.

Treatment by inverting the decapitated seedlings in 0·2 or 0·3% aqueous solution of colchicine for seven to eight or four to five hours respectively was found to yield a good number of mixochimeras. The existence of diploid-polyploid chimeras was confirmed from both morphological and cytological studies. Apart from the stunted growth which is attributed to the differential growth rates of $2x$ and $4x$ tissues (Avery *et al.*[1]), the appearance of dark and light green sectors in the leaves provided further evidence of mosaicism. A significant increase in the stomatal and epidermal cell size in the dark green sectors and the gradual disappearance of dark green sectors in the subsequently produced leaves provided indirect evidence of the induction of mixochimera and the onset of intrasomatic selection (Rasmusson and Levan[5]).

Cytological evidence came both from shoot tip squash and microtome sections of periodically fixed seedlings following colchicine treatment. Shoot apices were fixed periodically at intervals of 24 hours for eight days and squashed after staining with feulgen. Based on the cell and nuclear size and actual chromosome number, the diploid and polyploid cells were distinguished and their proportion calculated in the meristematic zone. The data showed a gradual increase in the proportion of polyploid cells till the fourth day following

colchicine treatment and a rapid fall from the fifth day onwards. As early as the seventh day, the proportion dropped to a level of 10% (Fig. 1). Similarly, a critical study of microtome sections of periodically fixed shoot apices after colchicine treatment showed a high proportion of periclinal and sectorial chimeras on the fourth and fifth days and a decrease on subsequent days (Fig. 3). The rise in the
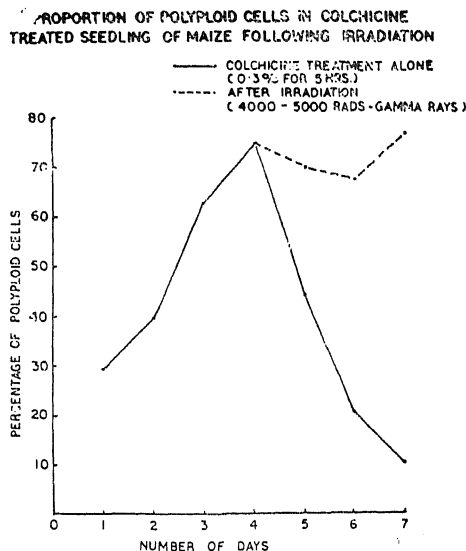
FIG. 1

beginning would suggest that a growing number of cells which were affected by mitotic delay following colchicine treatment, had commenced division. Thus, it may take a few days for the treatment to express its maximum potential. The decrease in the proportion of polyploid cells from the fifth day onwards can only be attributed to intrasomatic selection, since it is known that unaffected cells divide faster than the affected ones (Krythe and Wellenseik[3]). Chen (as quoted by Chen and Ross[2]) reported

that the diploidization starts immediately after the colchicine treatment in the case of *Sorghum*. However, the present investigation showed that there were two phases, the early phase covering the first four days when polyploid cells increase in total proportion and the later phase commencing from the fifth day where the proportion begins to decline rapidly.

Taking advantage of the superior radioresistance of polyploid tissue, an attempt was made to selectively eliminate the diploid tissue in the colchicine-induced mixochimeras through irradiation. To determine the dose of radiation which will preferentially damage diploid cells, normal maize seedlings at the same developmental stage were subjected to gamma irradiation. The L.D. 50 was found to range between 4,000 and 5,000 r. Using this information, four-day old colchicine-treated seedlings, which had the highest frequency of polyploid cells, were subjected to L.D. 50 doses of gamma-rays. Analysis of squash preparations of such seedlings, fixed at different intervals as mentioned earlier, showed a rise in the frequency of polyploid cells. The rise following the supplementary gamma-ray treatment provided a striking contrast to the rapid fall in the frequency of such cells in untreated seedlings. Sections of the shoot apex of colchicine-*cum*-radiation-treated seedlings revealed completely enlarged cells (Fig. 4). These results provide evidence for Lewis' view that intrasomatic selection in favour of diploid cells in a diploid-polyploid chimera could successfully be arrested through suitable radiation treatment. This technique will be of great value in many horticultural and ornamental plants where diplontic selection hinders the induction of polyploidy through colchicine treatment.

FIGS. 2-4. Fig. 2. Longitudinal sections of shoot apices of seedlings in control. Fig. 3. Colchicine treated, showing sectorial chimera. Fig. 4. Colchicine-*cum*-irradiated, showing all enlarged cells.

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SYNTHESIS OF FURANO-BENZOPYRONES*

Part VIII. Synthesis of 8-Methoxyfuranoisoflavones

A. S. R. ANJANEYULU, L. RAMACHANDRA ROW, C. SRI KRISHNA AND C. SRINIVASULU

Department of Chemistry, Andhra University, Waltair

DURING a programme of synthesis of rotenone analogues, the synthesis of 8-methoxyfurano-isoflavones was undertaken. This programme was also encouraged by the recent discoveries of furanoisoflavones, furanopterocarpans and related compounds from *Pachyrrihizus*[1-5] and *Neorautanenia*[5-7] species and more recently from *Swartzia madagascariensis*.[8]

6 : 7-Dihydroxy coumaran (I), not being sufficiently reactive in Nencki's reaction, its dimethyl ether (II) was condensed with substituted phenacyl chlorides in presence of aluminium chloride to yield the corresponding deoxybenzoins (Table I). This reaction was

The reduction of the aldehyde to benzyl alcohol was quickly and efficiently carried out by crossed Cannizaro reaction using formalin.[11] Thus anisaldehyde yielded ansyl alcohol and veratraldehyde, veratryl alcohol in good yields (70–80%). The product could be used directly without much purification. Reduction with Raney Ni/H$_2$ at 900 lbs./sq. inch gave varying results; with anisaldehyde, p-methoxy toluene was the major product while with veratralde-hyde the major product was the veratryl alcohol. The conversion of the benzyl alcohols to the phenylacetic acids by the scheme given above yielded consistent results. The azlactone synthesis, Willgerodt or Arndt-Eistert reaction

TABLE I

S. No.	6·OH-7·OCH$_3$-Coumaran	Yield	M.P.	Mol. formula	Required		Found	
					C	H	C	H
1	5·(ω-phenyl) acetyl (III)	40%	98°	C$_{17}$H$_{16}$O$_4$	71·8	5·7	71·6	5·8
2	5·(ω-p-methoxyphenyl) acetyl (IV)	50%	129°	C$_{18}$H$_{18}$O$_5$	68·8	5·8	69·1	6·1
3	5 (ω·3 : 4-dimethoxyphenyl) acetyl (V)	10%	169–70°	C$_{19}$H$_{20}$O$_6$	66·3	5·8	66·0	6·1

studied at 0° and also at 40° in ether medium. The latter produced yields of deoxybenzoins of the order of 40–50%. The I.R. spectra of these three deoxybenzoins (III, IV and V) showed significantly negligible absorption in hydroxyl region while the corresponding 6-hydroxy deoxybenzoins[9,10] (7-methoxyl absent) exhibited broad trough between 3560–3460 cm.$^{-1}$, although of a low intensity. This seems to suggest the sandwiched character of this hydroxyl between —OCH$_3$ and 5–CO in these compounds (III, IV and V) which exhibited brown ferric reaction.

Substituted phenylacetic acids can be prepared by several methods. In the present synthesis, these were prepared by the following sequence :

$$R—CHO \xrightarrow{\text{HCHO}} R—CH_2OH \xrightarrow{\text{SOCl}_2}$$

$$R—CH_2Cl \xrightarrow{\text{KCN}} R—CH_2CN \xrightarrow{\text{KOH}}$$

$$R—CH_2COOH,$$

I R=H
II R=CH$_3$
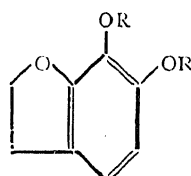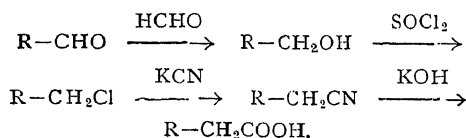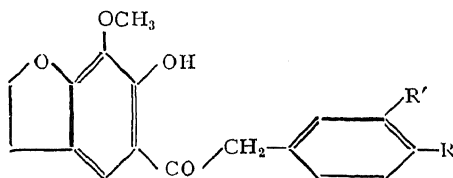
III R=R′=H $\left(\nu_{\text{max.}}^{\text{CHCl}_3} 163) \text{ cm.}^{-1} \right)$

IV R=OCH$_3$; R′=H $\left(\nu_{\text{max.}}^{\text{CHCl}_3} 1630 \text{ cm.}^{-1} \right)$

V R=R′=OCH$_3$ $\left(\nu_{\text{max.}}^{\text{CHCl}_3} 1630 \text{ cm.}^{-1} \right)$

TABLE II

S. No.	Compound	M.P.	Mol. formula	Required		
				C	H	
1	8-OMe-(4′ : 5′)-dihydrofurano (3′ : 2′: 6 : 7)-isoflavone	134°	$C_{18}H_{14}O_4$	73·5	4·8	73·'
2	8-OMe furano-(3′ : 2′ : 6 : 7)-isoflavone ..	166°	$C_{18}H_{12}O_4$	74·0	4·1	73·'
3	8, 4″-(OMe)₂-(4′:5′)-dihydrofurano (3′:2′:6:7)-isoflavone	147-48°	$C_{19}H_{16}O_5$	70·0	5·0	70·'
4	8, 4″-(OMe)₂-furano-(3′ : 2′ : 6 : 7)-isoflavone	153-54°	$C_{19}H_{14}O_5$	70·8	4·4	70·'
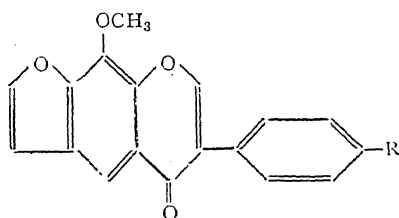
VIII   R=H $\left(\nu_{max.}^{Nujol}\ 1645\ and\ 1618\ cm.^{-1}\right)$

IX   R=OCH₃ $\left(\nu_{max.}^{Nujol}\ 1638\ and\ 1613\ cm.^{-1}\right)$
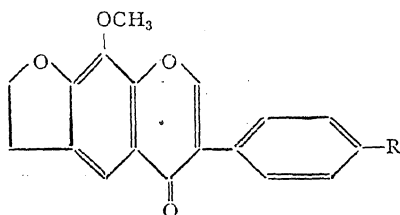
VI   R=H $\left(\nu_{max.}^{CHCl_3}\ 1650\ and\ 1620\ cm.^{-1}\right)$

VII   R=OCH₃ $\left(\nu_{max.}^{CHCl_3}\ 1650\ and\ 1620\ cm.^{-1}\right)$

involve costly reagents. Although, these have been followed extensively, the above conversion appears to be commendable for the synthesis of substituted phenylactonitriles or phenylacetic acids.

Cyclisation of the deoxybenzoins (III, and IV), using ethyl formate and metallic sodium afforded the corresponding dihydrofuranoiso-flavones (VI and VII). These exhibited feeble greenish-yellow fluorescence in conc. H_2SO_4. The yields (35–40%) of these isoflavones were poor compared to those secured wit[?] benzoins[9,10] without 7-methoxyls (50 [?]

The final stage of dehydrogen[?] effected with Pd-C (30%) by re[?] diphenyl ether for four hours. 8-M[?] 8 : 4″-dimethoxyfuranoisoflavones (V[?] IX) were secured in excellent yields [?] These furanoisoflavones (VIII and I[?] colourless crystalline compounds [?] light green fluorescence in conc. $H_2S[?]$

Finally, during the course of this [?] it appears that 7-methoxyl in 6 : 7-d[?] coumaran (II) exercises deleterious [?] in the synthesis of deoxybenzoin and it[?] tion reactions. Dehydrogenation was, [?] facile and afforded better yields.

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BENEDYNE, A NEW SYNTHETIC SOIL AGGREGATING CHEMICAL AND PLANT GROWTH STIMULANT FOR INCREASING CROP PRODUCTION: TRIALS WITH WHEAT

M. N. SINHA AND O. P. GAUTAM

Division of Agronomy, Indian Agricultural Research Institute, New Delhi-12

THE role of physical condition of soil in increasing crop production is well recognised. Maintenance of good physical condition means mainly creation of soil environment that is conducive to proper growth and functioning of micro-organisms, aeration of soil through improvement in aggregation, increased intake of irrigation or rain-water and better retention of moisture thus received in the root zone and finally greater availability of soil moisture to the crop plants.

Traditionally organic matter has been used to improve soil physical condition in most cases. It is only recently that certain chemical substances have been put in the market which, even when applied in comparatively minute quantities, bring about very significant improvement in soil aggregation and other physical conditions of the soil and thus help to increase soil productivity. Benedyne (NF-42), an organic liquid concentrate derived from the controlled fermentation of natural organic matter, is one such chemical which is claimed to have been used with great advantage in crop production by the manufacturers, Messrs. United Soil Builders of California, U.S.A. Within its water base benedyne is reported to contain various biochemical substances of a micro-organic nature, which include soil micro-organisms and natural growth factors. These substances work with existing soil constituents to effect improved granular soil structure. Benedyne's living soil micro-organisms and other organic substances accelerate and encourage the natural activities of micro-organisms already present in the soil. These micro-organisms play an essential role between the soil constituents and growing plants, providing assimilable nutrients to the plant and improving the structure of the soil. Benedyne benefits plant growth by making greater amounts of micro-nutrients and mineral elements available to plants through the stimulation of the soil's micro-organic activities. These biological activities also create an environment which allows air, water and nutritional elements to get to the roots of the plant. The soils must contain sufficient humus and

plant food elements for best benedyne results. If the soil is deficient in these elements, it is recommended to be treated with a balanced organic or inorganic fertilizer, along with any necessary soil amendment. Benedyne, plus a normal soil programme of fertilization and irrigation, is reported to bring out the full potential of any soil.

Benedyne was first received in the year 1965 and was tried in a field experiment on wheat conducted during rabi 1965-66. The results which turned out to be encouraging are reported here.

The experiment was conducted in light sandy soil with medium fertility at the farm of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi. The chemical composition of the soil (0-15 cm.) prior to sowing and application of manures and fertilizers showed 0·48% organic carbon with 198 kg. available N, 15 kg. available P_2O_5 and 227 kg. available K_2O per hectare, with soluble salts 0·30 m. mhos./cm. and a pH of 7·8. The effect of benedyne (305 ml. per square meter) was investigated with farmyard manure (100 q./ha.) and a combination of ammonium sulphate, single superphosphate and muriate of potash at the rate of 50 kg. N, 25 kg. P_2O_5 and 50 kg. K_2O per hectare in a randomized block design. This was fairly approximating the NPK content of the farmyard manure used in the other treatments. Following the application of test material and the fertilizers to each plot treatmentwise the entire field was irrigated. Wheat variety N.P. 718 was sown on 20th November 1965 in rows 18 cm. apart after necessary field preparation.

Data on grain and straw yield as well as on degree of soil aggregation are presented in Table I.

It may be noted that the effect of benedyne was quite marked when it was applied with organic manure. An increase of 34·3% and 37·2% in the yields of grain and straw respectively over farmyard manure alone was found to be statistically significant. On the other hand, when benedyne was applied with inorganic fertilizers, there was a reduction in the yields

3

Effect of Benedyne on yield of wheat and soil aggregation

Sl. No.	Treatment	Yield of wheat (q./ha.)		Soil aggregates >0·25 mm. %
		Grain	Straw	
1	Farmyard manure ..	20·24	34·98	21·17
2	Farmyard manure + Benedyne	27·17	48·01	26·43
3	Inorganic fertilizers	31·36	55·46	20·76
4	Inorganic fertilizers + Benedyne	28·01	51·00	17·78
	S.Em.	± 1·31	± 3·06	±2·29
	C.D. at 5%	4·53	10·58	N.S.
	C.D. at 1%		5·82	13·59

of grain and straw to the extent of 10·7% and 8·2% respectively as compared to inorganic fertilizers alone.

Soil aggregation analysis revealed that benedyne and farmyard manure resulted in maximum soil aggregation thereby suggesting that the increase in the yield of crop was ascribable mainly to the physical condition of the soil resulting from the application of the test material and organic manure. More intensive investigation to assess the effect of Benedyne on the physical condition of the soil and the increase in crop yield resulting from such improvement in soil structure is under investigation.

THE INHIBITORY ACTION OF ALLOXAN IN THE EARLY DEVELOPMENT OF CHICK EMBRYO

B. A. DIWAN

Department of Zoology, University of Poona, Poona-7

ALLOXAN-INDUCED maternal diabetes in animals has been studied by several investigators and various incidences of congenital malformations have been recorded.[1-3] Still there is no agreed opinion on the mechanism of action of alloxan in tissue metabolism, although the drug is known as an oxidising agent for thiols[4] and may therefore disturb the –SH metabolism of the embryos.[5] It was, therefore, felt desirable to study the action of alloxan on the early morphogenesis of chick embryos, and the reversal of its action by supplying the embryos with –SH groups.

The eggs were obtained from a white leghorn. After an initial incubation of 14 hours at 37·5° C., they were explanted *in vitro*.[6] Alloxan of concentration M/50 was applied directly on the ventral surface of the embryo. After treatment, the embryos were grown further for six hours. They were then washed carefully to remove all traces of alloxan. 0·1 ml. of fresh Pannett Compton solution was added and the embryos were incubated for further 20–21 hours. In the second set of experiments, the alloxan was removed after a six-hour treatment as described above and glutathione (–SH groups) was added inside the ring and the embryos were developed further.

In all 100 embryos were used in the present investigation of which 50 were treated with alloxan alone and 30 with alloxan followed by glutathione. The remaining 20 embryos received no chemical treatment. Alloxan treated embryos showed abnormalities mainly in the brain region and neural tube, the latter remaining widely open along most of its length and the brain showing little or no differentiation into vesicles (Fig. A). Several sections of control and treated embryos confirmed that the neural tube in the treated embryo was wide open (Fig. B). The neural folds had formed but failed to meet and fuse in the mid-line.

Reversal with Glutathione.—Two concentrations of glutathione were used ($5 \cdot 10^{-4}$ M and $4 \cdot 10^{-4}$ M). With each of these concentrations, the embryos were completely protected and resembled in every respect the controls (Figs. C and D).

Alloxan is suggested as an oxidising agent for thiols.[4] Administration of thiols (cysteine, glutathione, etc.) protects the embryos from alloxan diabetes, thereby indicating the importance of thiol groups in diabetes.[7-8] Lazarrow[8] believes that beta cells of pancreas are rich in –SH groups, which are necessary for the synthesis of insulin. Alloxan, by combining with those of –SH groups or oxidising them, would depress the insulin formation. The above results indicate that, for the normal growth and differentiation of the brain and
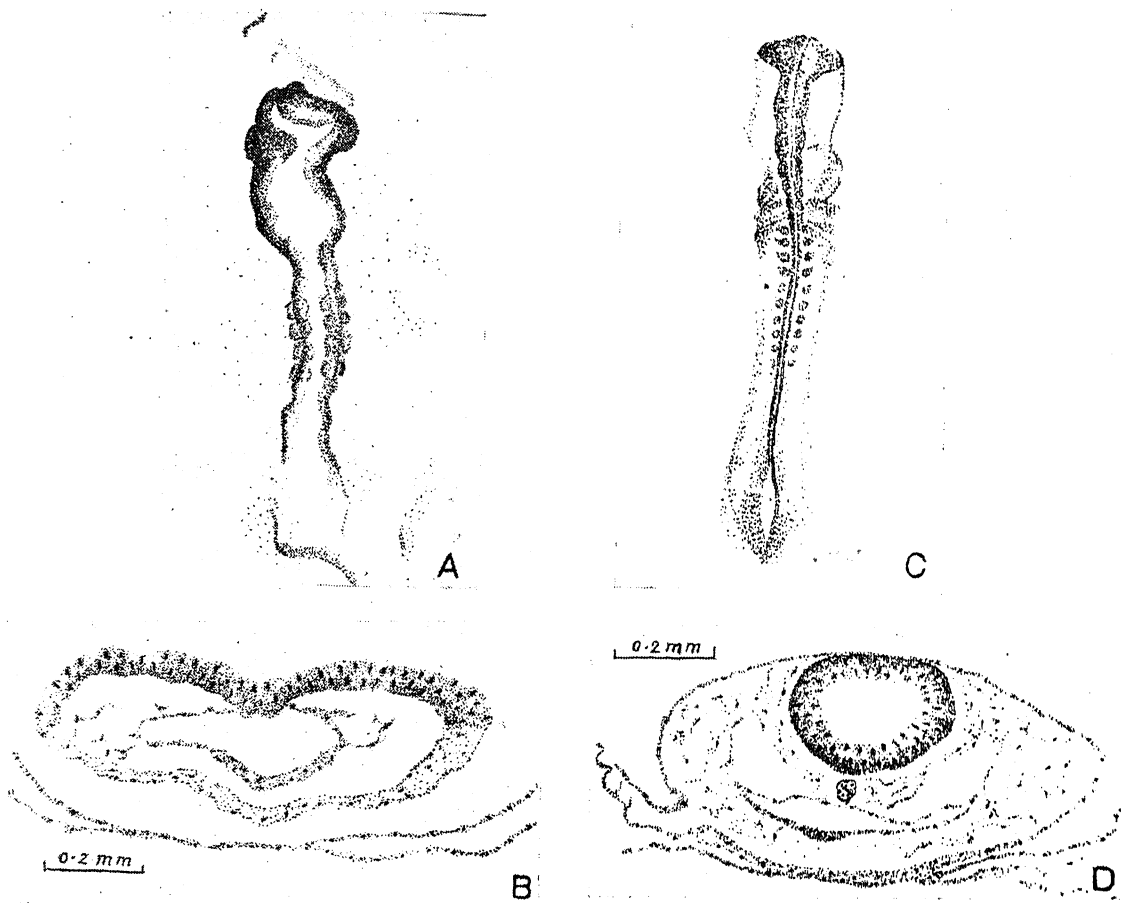
FIGS. A–D.   Fig. A.   Embryo treated with Alloxan at definitive streak stage.   Fig. B.   Transverse section through an embryo treated with Alloxan at definitive primitive streak stage.   Note a wide open nural tube. Fig. C.   Embryo treated with Alloxan at difinitive primitive streak stage followed by a treatment with glutathione. Fig. D.   Transverse section of embryo treated with Alloxan at definitive primitive streak stage followed by treatment with glutathione.

neural tube, adequate quantities of –SH groups appear to be essential.   The teratogenic effect of alloxan may be due to its oxidative or combining effect –SH groups.   This assumption is further corroborated by the abolition of the teratogenic effect of alloxan in the chick explants with glutathione.

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LETTERS TO THE EDITOR

A SPECIAL FEATURE OF WORLD-LINES IN CONFORMALLY RELATED SPACE-TIMES

My attention has been drawn by Professor V. V. Narlikar to the fact that if the principle

$$\delta \int \bar{R} \sqrt{(-\bar{g})}\, d^4x = 0 \qquad (1)$$

is used for restricting $\sigma(x^i)$ in

$$d\bar{s}^2 = \bar{g}_{ij} dx^i dx^j = (g_{ij} e^{2\sigma})\, dx^i dx^j = e^{2\sigma} ds^2 \quad (2)$$

one arrives at the condition [Eisenhart (1926) for notation]

$$\sigma_{,\sigma} - \sigma_{,\sigma} = 0 \qquad (3)$$

or

$$(e^{\sigma})_{,\sigma} = 0. \qquad (4)$$

(4) is the familiar wave equation, usually expressed as $\square e^{\sigma} = 0$.

Because of the physical significance of (4) it is suggested that the conformal transformation can be used under certain circumstances, to represent the effect of a field perturbation of physical significance in terms of an 'imaginary' conformal metric. Of course, the argument is valid even when (4) is not satisfied.

One can verify that the geodesics

$$\frac{d^2 x^i}{ds^2} - \Gamma^i_{jk} \frac{dx^j}{ds} \frac{dx^k}{ds} = 0 \qquad (5)$$

assume the form, in going over from g_{ij} to $\bar{g}_{ij}$,

$$\frac{d^2 x^i}{d\bar{s}^2} - \bar{\Gamma}^i_{jk} \frac{dx^j}{d\bar{s}} \frac{dx^k}{d\bar{s}}$$
$$= \sigma_{,j}\left(\frac{dx^j}{d\bar{s}} \frac{dx^i}{d\bar{s}} - \bar{g}^{ij} \right). \qquad (6)$$

It may be seen that the term on the right represents a vector perpendicular to $dx^i/d\bar{s}$ for

$$\sigma_{,j}\left(\frac{dx^j}{d\bar{s}} \frac{dx^i}{d\bar{s}} - \bar{g}^{ij} \right) \frac{dx^k}{d\bar{s}} \bar{g}_{ik} = 0.$$

Hence if we consider for the metric

$$d\bar{s}^2 = \bar{g}_{ij} dx^i dx^j \qquad (2\,a)$$

the world-lines of test particles affected by the forces on the right-hand side of (6) the same world-lines can be interpreted as the geodesics of the imaginary space of the metric

$$ds^2 = g_{ij} dx^i dx^j. \qquad (2\,b)$$

We have an interesting illustration in Schwarzschild's internal solution for a homogeneous fluid sphere which may be presented (Synge, 1964) as

$$\bar{g}_{11} = - (1 - qr^2)^{-1},$$

$$\bar{g}_{22} = - r^2,$$

$$\bar{g}_{33} = - r^2 \sin^2\theta,$$

$$\bar{g}_{44} = [A - B \sqrt{(1 - qr^2)}]^2, \qquad (7)$$

all other components of the metric tensor vanishing. For this metric

$$\bar{p} = \frac{q}{8\pi}\left[\frac{3B \sqrt{(1 - qr^2)} - A}{A - B \sqrt{(1 - qr^2)}} \right], \quad \bar{\rho} = \frac{3q}{8\pi} \Biggr\}$$

where

$$A = \frac{3 \sqrt{(1 - qr^2)}}{2}, \quad B = \frac{1}{2} \Biggr\} \qquad (8)$$

and the equations $\bar{T}^{ij}_{;j} = 0 \qquad (9)$
give for a perfect fluid representation (Synge, 1964)

$$\frac{d^2 x^i}{d\bar{s}^2} + \bar{\Gamma}_{jk}^i \frac{dx^j}{d\bar{s}} \frac{dx^k}{d\bar{s}}$$
$$= - \frac{\bar{p}_{,j}}{\bar{p} + \bar{\rho}}\left(\frac{dx^j}{d\bar{s}} \frac{dx^i}{d\bar{s}} - \bar{g}^{ij} \right). \qquad (10)$$

Comparing (10) with (6) we get

$$- \frac{\bar{p}_{,j}}{(\bar{p} + \bar{\rho})} = \sigma_{,j} \qquad (11)$$

and hence

$$e^{\sigma} = A - B \sqrt{(1 - qr^2)}. \qquad (12)$$

The other metric now is given by

$$g_{11} = - [A - B \sqrt{(1 - qr^2)}]^{-2} (1 - qr^2)^{-1},$$
$$g_{22} = - r^2 [A - B \sqrt{(1 - qr^2)}]^{-2},$$
$$g_{33} = - r^2 \sin^2\theta [A - B \sqrt{(1 - qr^2)}]^{-2},$$
$$g_{44} = 1,$$

all other components of the metric tensor vanishing. (10) are the geodesics of this line-element. We call this metric space imaginary because the tensor T^{ij} given by this is irrelevant so far as (10) is concerned.

We are exploring further this method to find whether the world-lines of test particles in $(2\,a)$ or $(2\,b)$ can describe the effect of an interaction with an extraneous field of physical significance in $(2\,b)$ or $(2\,a)$ respectively the connecting link being (4). (11) and (12) arose in the course of a discussion with Professor V. V. Narlikar to whom the author's grateful thanks are due.

Dept. of Mathematics and   M. M. KUMAR.
  Statistics, University of Poona,
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SPACE GROUP AND UNIT CELL DIMENSIONS OF DIGLYCINE STRONTIUM CHLORIDE TRIHYDRATE AND DIGLYCINE MANGANESE CHLORIDE

THE investigation of the crystal structures of diglycine barium chloride monohydrate, diglycine strontium chloride trihydrate and diglycine manganese chloride has been taken up in this laboratory to gather information regarding the orientation of the glycine units in its different addition compounds and also to study the nature of the hydrogen bonds present. The preliminary results obtained with the strontium and manganese compounds are given here.

Diglycine strontium chloride trihydrate was crystallised by slow evaporation of an aqueous solution of glycine and strontium chloride in stoichiometric proportions. The sample used for collecting X-ray diffraction data was cut from a big crystal, along 'b' and 'c' axes and ground to needles of thickness 0·30 mm. Rotation and Weissenberg photographs established the crystal to be orthorhombic with a tetramolecular unit cell of dimensions :

$a = 16·52$ Å ; $b = 9·34$ Å ; and $c = 8·25$ Å ($\pm 0·015$ Å). From systematic absences in the Weissenberg photographs, the space group could be uniquely identified as P_{bcn}. The density of the crystal was measured by flotation method using bromoform and trichloroethylene.

$d_{measured} = 1·90$ mg./c.c.
$d_{calculated} = 1·892$ gm./c.c. The number of molecules in the unit cell, $Z = 4$.

Diglycine manganese chloride was also crystallized by slow evaporation of an aqueous solution of glycine and manganese chloride in stoichiometric proportions. Three prominent zone axes were chosen as rotation axes for collecting X-ray diffraction data. Absence of rotation and mirror symmetries established the crystals to be triclinic with the following dimensions for the unit cell. These were obtained from the 'a' and 'c' axes rotation and Weissenberg photographs and by the application of Buerger's offset method[1] to higher level pictures. The space group is P1 or P$\bar{1}$.

$a = 4·96$ Å, $b = 8·16$ Å, $c = 7·01$ Å ($+ 0·015$ Å)
$a = 111°·48'$, $\beta = 115°·20'$, $\gamma = 103°·30'$ ($+1°$).
The density of the crystal, measured by flotation method using a mixture of bromoform and trichloroethylene, gives only one molecule in the unit cell.

$d_{measured} = 1·94$ gm./c.c.
$d_{calculated} = 1·932$ gm./c.c.

The authors thank Professor S. Chandrasekhar for his interest in the problem.

Dept. of Physics,   P. NARAYANAN.
Univ. of Mysore,   SHANTA VENKATARAMAN.
Mysore-6,
May 20, 1967.

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STUDY OF ULTRASONIC VELOCITY IN MOLTEN METALS

ULTRASONIC velocity is studied in the liquid state over a wide temperature range in the elements sulphur, cadmium, zinc and tellurium. The phase path interference pulse technique[1] is employed and two fused quartz rods are used to serve as delay lines and also to isolate the transmitting and receiving X-cut quartz crystals of 3 Mc./sec. fundamental from these high temperatures. Metals when melted will be oxidised to a great extent and form a coating on the quartz rod absorbing completely the ultrasonic signal. As there is no provision for vacuum melting, an eutectic mixture of KCl + LiCl is covered over the melt to prevent oxidation and to give an acoustic contact as done by Kleppa.[2] Only in the case of sulphur, nitrogen atmosphere is provided by a continuous flow to prevent oxidation.

The velocity values in sulphur at lower temperatures are slightly higher though the general shape of the velocity-temperature curve is similar to that obtained by the earlier workers.[3-5] No jump (Fig. 1) in velocity near
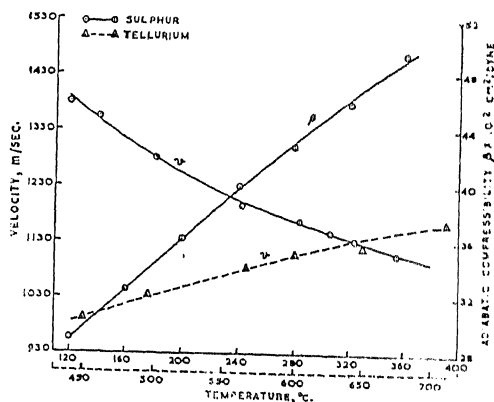
FIG. 1

160° C. is observed as reported by Pryor and Richardson.[4] The velocity decrease with temperature is not strictly linear and the gradient is high at lower temperatures and changes to

TABLE I

Molar sound velocity

Temperature °C.		120	200	280	360	440	480	520	600	650
~~ ~~	..	197·6	197·2	197·6	197·6	..	..	..	..	..
~~	..					187·0	187·8	187·3	187·5	187·4
~~	..	..	..	... .	..	134·5	136·3	137·4	137·7	137·7

~~~~ values at higher temperatures. This ~~~~~~~~ is also reflected in the adiabatic ~~~~~~~~~~. But the molar sound velocity[6] ~ = $M V^{3} P$ is fairly constant over the temperature range (Table I). Though the velocity ~~ cadmium (Fig. 2) decreases linearly with ~~ ~~~~~~~, the adiabatic compressibility curve ~~~~ a slight convexity with temperature. H~~~~~ the molar sound velocity is constant ~~ ~~~ temperature range studied. In the case ~ ~~~ Fig. 2) the interesting feature is that ~~ velocity first increases with temperature

FIG. 1

~~~ reaches a maximum around 500° C. and ~~~~ falls off quite linearly. A corresponding ~~~~~~~ is observed in adiabatic compressi-~~~~~ curve around the same temperature. ~~~~ may be due to a change in the dual ~~~~~~~~ of the melt around this temperature. ~~~ value of molar sound velocity can be taken ~~ almost constant over the temperature range ~~~~~~ as small variations can be neglected in ~~~~ studies. The velocity in tellurium increases w~~~ temperature (Fig. 1) throughout the temperature range studied, contrary to the behaviour of other melts so far studied. As

the density data is not available in literature, the compressibility and molar sound velocity are not calculated.

We are grateful to Prof. B. Ramachandra Rao for his interest and our thanks are due to the C.S.I.R. for the financial assistance.

Andhra University,   T. KRISHNA MURTHY.
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VARIATION OF ULTRASONIC ABSORPTION IN CS₂ WITH IMPURITY

IT has been experimentally observed that addition of a small amount of impurity of low absorbing liquid to a heavily absorbing liquid will remarkably reduce the coefficient of ultrasonic absorption. Such study in binary mixtures of unassociated liquids furnished the results which gave support to the explanation of the excess absorption on the basis of thermal relaxation of vibrational modes. The findings obtained for benzene-toluene and benzene-carbon tetrachloride mixtures fitted well to the theory suggested by Bauer[1] and its extended form by Sette.[2]

But it is strange that though CS_2 is the most pronounced Kneser liquid, no report has been made so far of a study of the effect of low absorbing liquids as impurity in it on its absorption coefficent of ultrasonic waves. It is, however, generally reported[3] that the absorption coefficent in CS_2 will fall rapidly, but no exact theoretical account has been given for any an experimental comparison. In the present work an experimental finding of ultrasonic absorption in CS_2 is reported when xylene and kerosene are added to it as impurities.

The experiment was performed with one ultrasonic generator consisting of a full-wave rectifier and an oscillating circuit of the Hartley type. The vibrating quartz of natural frequency

1 mc./s. was made to vibrate at 2·87 mc./s. inside a rectangular glass vessel containing rectified CS_2 supplied by E. Merck. Now by the optical

FIG. 1

FIG. 2

TABLE 1

f—2·87 mc./s.	Temperature—27° C.
% of xylene in CS_2 in mole fraction × 10²	$a/f^2 \times 10^{17}$ c.g.s. a-Amplitude abs. coeff.
0	5920
0·048	4420
0·0958	4200
0·143	3970
0·238	3520
0·334	2987
0·476	2360
0·712	2180
0·95	1840
1·42	1174
1·874	1119
2·34	869
2·88	746
3·24	694
3·74	657
5·14	426
6·10	354

arrangement reported by one of the authors[4] the coefficient of ultrasonic absorption was found at different concentrations. Xylene supplied

by E. Merck and kerosene were added very carefully to CS_2 with the help of an accurate burette. The mole fraction of xylene in CS_2 was calculated by taking densities of CS_2 and xylene as 1·29 and 0·86 gm./c.c. respectively.

It will be apparent from Tables I and II that in 1% mixture ($0·476 \times 10^{-2}$ mole fraction of xylene in CS_2 in Table I) a/f^2 is 2360 for xylene and 2988 for kerosene (in Table II). Similarly in 10% mixture ($5·14 \times 10^{-2}$ mole fraction of xylene) a/f^2 is 426 for xylene and 1024 for kerosene. This comparison shows that xylene in volume % is more effective in reducing a/f^2 of CS_2 than kerosene.

TABLE II

f—2·87 mc./s.	Temperature—27° C.
% of kerosene in CS_2 by volume	$a/f^2 \times 10^{17}$ c.g.s.
0	5920
1	2988
2	2169
3	1892
4	1253
5	1190
10	1024
20	333

Physics Department,   K. SAMAL.
Ravenshaw College,   S. C. DAS.
Cuttack-3 (India), *January* 27, 1967.

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THIOCYANATO ZINC (II) COMPLEXES —NITROGEN CO-ORDINATION

As a part of a series of investigations on d^{10} metal complexes, we reported[1] earlier some tetrahalo complexes of zinc (II). In this communication, we report complexes obtained by reacting zinc thiocyanate with ligands containing nitrogen donor atom, *viz.*, γ-picoline, 4-vinyl and 2-amino pyridine and 4-aminoantipyrine.

An ethanolic solution of zinc thiocyanate was treated with an ethanolic solution of the ligand in 1 : 2 proportion. The separated compounds were suction-filtered, washed with ethanol and dried *in vacuo*. The purity of the compounds was established by estimating the metal and the thiocyanate by standard methods. The

TABLE I

Analysis, M.P. and conductance of thiocyanato zinc (II) complexes with nitrogen ligands

Compound	M.P. (°C.)	% Zinc		% Thiocyanate		Λ_M (mhos) in acetone
		Found	Required	Found	Required	
1. Dithiocyanato tetrakis-(γ-picoline) zinc (II)	186	11·26	11·76	20·63	20·98	29·4
2. Dithiocyanato bis-(4-Vinylpyridine) zinc (II)	157	16·39	16·63	29·3	29·67	53·0
3. Dithiocyanato bis-(2-amino pyridine) zinc (II)	165	17·11	17·62	31·01	31·45	59·5
4. Dithiocyanato bis-(4-amino antipyrine) zinc (II)	203	11·01	11·08	19·5*	19·76	60·9

* Computed from sulphur estimation since the ligand interferes in the estimation of thiocyanate as AgCNS.

analytical and conductance data are recorded in Table I.

All these compounds are soluble in acetone in which medium they are *essentially* non-electrolytes. The magnetic susceptibility measurements were made over solid specimens at room temperature using Gouy method and all the compounds were found to be diamagnetic. The IR absorption spectrum of the complexes as Nujol mulls were recorded using a Unicam SP-200 spectrophotometer. In addition to the modified (as a result of co-ordination) ligand absorption bands, very sharp bands were observed at 2100, 2100, 2080 and 2080 cm.$^{-1}$ respectively due to the v (C-N) of the co-ordinated thiocyanate group. While reporting the IR spectra of thiocyanato complexes of manganese (II), we distinguished[2] between terminal and bridging thiocyanate groups and accordingly there are only terminal groups in the compounds now reported.

Divalent zinc ion has a completely filled $3d^{10}$ non-bonding shell. Hence, under favourable conditions, it can form tetra, penta or hexa-co-ordinated complexes involving the use of $4s4p^3$, $4s4p^3 4d$ or $4s4p^3 4d^2$ hybrid orbitals. The bis-compounds, $ZnL_2(CNS)_2$, (Table I) are evidently four-co-ordinated possessing a tetrahedral shape whereas the tetrakis compound $ZnL_4(CNS)_2$ is hexa-co-ordinated. The low value for Λ_M in acetone indicates that it is not ionic since the value in acetone for even 1 : 1 electrolytes is round about 150 mhos. The low melting point, solubility in organic solvents like acetone and alcohol and a shining crystalline form are also suggestive of covalent bond formation. The tetrakis compound only was obtained even when less than the stoichiometric amount of the ligand was used. This compound [Zn(γ-pico)$_4$(CNS)$_2$] loses weight on heating at 110° C. corresponding to the loss of one molecule of the ligand. The calculated percentage loss in weight is 16·82 whilst the observed value is 16·48. No further in weight was noticed even if it is kept at for a further 5 hour period. This com-

pound, on analysis, corresponded to the composition [Zn(γ-pico)$_3$(CNS)$_2$]. (M.P.—161° C, %CNS calculated : 25·2, Found : 24·9). This appears to be penta-co-ordinated. Earlier, a distorted trigonal bipyramidal configuration was assigned[3] to a five-co-ordinated [Zn(terpyridyl)Cl$_2$] and the compound under report, [Zn(γ-pico)$_3$ (CNS)$_2$], may be yet another example of this unusual co-ordination. When this compound was treated with diethyl ether to obtain better crystalline form, strangely it changes over to a white flaky tetra-co-ordinated compound having the formula [Zn(γ-pico)$_2$(CNS)$_2$] (M.P.—85°, %CNS calculated : 31·61, Found : 31·1). This indicates that the penta-co-ordinated complex is not very stable as expected. Whilst the tetra-co-ordinated compound could also be obtained by heating the [ZnL$_4$(CNS)$_2$] to 140° C., it could not be obtained directly by refluxing [ZnL$_4$(CNS)$_2$] in ether medium. The following scheme summarises the interconversions of these compounds :

(1) Thermal decomposition at 110° C.; (2) treatment with diethyl ether; (3) thermal decomposition at 140° C.

Full details of this investigation will be published elsewhere.

Dept. of Chemistry,   S. Guru.
Regional Engineering   D. V. Ramana Rao.
College,
Rourkela-8 (Orissa), *December* 12, 1966.

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ACETATES OF THE REDUCED ANALOGUES OF VILANGIN AND ANHYDROVILANGIN

An earlier publication[1] deals with some condensation reactions of embelin with various aldehydes giving analogues of vilangin and anhydro-dust by boiling during 2–3 hr. The acetates thus obtained are colourless and these could be hydrolysed and oxidised by air to give the corresponding analogues of vilangin and anhydrovilangin. The following table gives a summary of the condensations effected.

TABLE I

Product	Reductive acetate	Appearance (colourless)	M.P.	Formula	Analysis (theoretical in brackets)
9-Methylvilangin or 9-methyl-anhydrovil-angin	9-Methylhexa-O-acetyl-tetrahydro-anhydrovil-angin	Prisms (Pet. ether)	86– 88°	$C_{48}H_{68}O_{13}$	C, 67·74 (67·61) H, 8·04 (7·98) –COCH₃, 30·64 (30·28)
9-Ethylvilangin or 9-ethyl-anhydrovilan-gin	9-Ethylhexa-O-acetyl-tetrahydro-anhydrovil-angin	,,	128–130°	$C_{49}H_{70}O_{13}$	C, 68·12 (67·90) H, 8·34 (8·08) –COCH₃, 30·32 (29·80)
9-Phenylvilangin or 9-phenyl-anhydrovil-angin	9-Phenylhexa-O-acetyl-tetrahydro-anhydrovil-angin	Plates (Pet. ether)	120–122°	$C_{53}H_{70}O_{13}$	C, 69·82 (69·60) H, 7·42 (7·66) –COCH₃, 28·46 (28·23)
9-Benzylanhydrovilan-gin	9-Benzylhexa-O-acetyl-tetrahydro-anhydrovil-angin	,,	97– 99°	$C_{54}H_{72}O_{13}$	C, 70·04 (69·84) H, 7·52 (7·66) –COCH₃, 28·04 (27·81)
9-(β-Phenylvinyl) an-hydrovilangin	9-(β-Phenylvinil)·hexa-O-acetyltetrahydroan-hydrovilangin	Prisms (Pet. ether)	124–125°	$C_{55}H_{72}O_{13}$	C, 70·46 (70·21) H, 7·92 (7·66) –COCH₃, 27·82 (27·45)
9-(Dimethylamino) phenyl anhydrovil-angin	9-(4'-Dimethylamino-phenyl) hexa-O-acetyl-tetrahydro-anhydrovil-angin	Plates (Pet. ether)	75– 77°	$C_{55}H_{75}O_{13}N$	C, 68·82 (68·96) H, 7·64 (7·84) –COCH₃, 27·31 (26·96)
9-(Methoxyphenyl) anhydrovilangin	9-(4'-Methoxyphenyl) hexa-O-acetyltetrahy-dro-anhydrovilangin	Plates and Prisms (Pet. ether)	122–124°	$C_{54}H_{72}O_{14}$	C, 68·72 (68·64) H, 7·81 (7·63) –COCH₃, 27·64 (27·33)
9-(Dinitrophenyl) anhydrovilangin	9-(3':5'-Dinitrophenyl)-hexa-O-acetyltetrahy-dro-anhydrovilangin	,,	102–104°	$C_{53}H_{68}O_{17}N_2$	C, 63·52 (63·36) H, 6·81 (6·77) –COCH₃, 26·04 (25·69)
9-(3'-4'-Methylenedi-oxyphenyl) anhydro-vilangin	9-(3':4'-Methylenedi-oxyphenyl)-hexa-O-ace-tyltetrahydroanhydro-vilangin	Plates (Pet. ether)	94– 96°	$C_{54}H_{70}O_{15}$	C, 67·72 (67·64) H, 7·42 (7·31) –COCH₃, 27·14 (26·93)
9-(3:4'-Dimethoxy-phenyl)-anhydrovil-angin	9-(3:4'-Dimethoxyphe-nyl)-hexa-O-acetylte-trahydroanhydrovilan-gin	Plates and Prisms (Pet. ether)	140–142°	$C_{55}H_{74}O_{15}$	C, 67·81 (67·75) H, 7·52 (7·60) –COCH₃, 26·57 (26·49)
9-(2'Hydroxyphenyl) anhydrovilangin	9-(2'-Acetyloxyphenyl)-hexa-O-acetyltetrahy-droanhydrovilangin	Short Prisms (Pet. ether)	210–212°	$C_{55}H_{72}O_{15}$	C, 67·62 (67·89) H, 7·21 (7·41) –COCH₃, 31·37 (30·96)
9-(3 Nitrophenyl) an-hydrovilangin	9-(3'-Nitrophenyl)-hexa-O-acetyltetrahydroan-hydrovilangin	Plates and Prisms (Pet. ether)	81– 82°	$C_{53}H_{69}O_{15}N$	C, 66·46 (66·33) H, 7·27 (7·19) –COCH₃, 27·12 (26·90)
9-(2'6'Dimethoxy-phenyl) anhydrovil-angin	9-(2':6'-Dimethoxyphe-nyl)-hexa-O-acetyltetra-hydroanhydrovilangin	,,	176–178°	$C_{55}H_{74}O_{15}$	C, 67·92 (67·75) H, 7·82 (7·60) –COCH₃, 26·91 (26·49)
9-(2'Hydroxy-3'-me-thoxyphenyl) anhy-drovilangin	9-(2'-Acetyloxy-3 -me-thoxyphenyl) hexa-O-acetyltetrahydroanhy-drovilangin	,,	194–196°	$C_{56}H_{74}O_{16}$	C, 67·12 (67·02) H, 7·54 (7·39) –COCH₃, 30·42 (30·04)

The nature of this condensation as active methylenic groups and not the benzoquinone systems was confirmed by the ready formation of the acetates of their reduced products by reductive acetylation. In all these cases, the product was acetylated using acetic anhydride, a trace of triethylamine and zinc

Dept. of Chemistry,   V. Krishna Murty.
Engineering College, T. V. Padmanabha Rao.
Andhra University,   V. Venkateswarlu.
Waltair, *January* 12, 1967.

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URANIUM (IV) SUCCINATES AND TARTRATE

preparation of Uranium(IV) has shown that UO^{+2} ion is forming a parallel series of compounds with that of normal Uranium(IV) ion the number of compounds containing the Oxouranium (IV) entity, UO^{+2}, is In continuation of our investigation preparation of Uranium(IV) compounds, two compounds a succinate having the formula $U_2O(C_4H_4O_4)_3$ $C_4H_4O_6$, $5H_2O$ respectively which with the ionic species UO^{+2} and U^{+4} in the same compound. Besides an $UO C_4H_4O_4$, $3H_2O$ has also been pactolytic method.

preparation of the simple oxysuccinate reduced solution of uranyl treated with succinic acid so that Uranium(IV) to succinate ion was The resulting solution was further sunlight for 10–12 hours when occurred and the light green $UO C_4H_4O_4$. $3H_2O$ was obtained.

The Uranium (IV) succinate, $U_2O(C_4H_4O_4)_3$, both the ionic species, UO^{+2} and obtained by the action of succinic acid small quantities on hydrated IV oxycarbonate[7] till all the carbon was removed and the reaction The compound was readily green precipitate.

procedure adopted for the tartrate compound $U_2O C_4H_4O_6$, $5H_2O$ was the same as the oxysuccinate. The analytical results in Table I.

TABLE I

Formula of the compound		% found	% calculated
$C_4H_4O_4$, $3H_2O$	Uranium	56·77	56·13
	Succinate	27·16	27·35
	Carbon	11·20	11·32
	Hydrogen	2·36	2·35
$C_4H_4O_6$	Uranium	50·43	50·68
	Succinate	41·39	42·07
$C_4H_4O_6$, $5H_2O$	Uranium	45·80	46·40
	Tartrate	43·00	43·28
	Carbon	13·89	14·04
	Hydrogen	2·39	2·14

We have been unable to isolate any definite tartrate compound from Uranium(IV) oxy carbonate.

Chemistry Department, K. C. SATAPATHY.
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and
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ACTION OF 2-CHLORO-4-AMINO-BENZOIC ACID IN *OCHROMONAS MALHAMENSIS*

A VARIETY of sulphur-free compounds, structurally related to p-aminobenzoic acid, have been shown to possess antimicrobial activity.[1-3] Out of a number of halogenated derivatives of p-ABA prepared by Wyss *et al.*,[4] 2-chloro-4-aminobenzoic acid (2-Clp-ABA) was found to be as active as sulpha drugs in certain cases. But it was claimed that 2-Clp-ABA radically differed from sulphonamides in that this could be a specific inhibitor of methionine biosynthesis.[4]

With a view to elucidate the mode of action of this antimetabolite in *Ochromonas malhamensis*, its effect on growth and the folate status was determined. Details of growth conditions, folic acid extraction and estimation were as described by us in an earlier report.[5]

It was observed that, when included in the growth medium, 2-Clp-ABA did not interfere with folic acid metabolism in *O. malhamensis*, in spite of its being a structural analogue of p-AMA, a precursor of folic acid (Table I).

TABLE I
Effect of 2-Clp-ABA on the folate status of O. malhamensis

2-Clp-ABA µg. per ml. of growth medium	Per cent. growth	Folic acid m µg. per mg. dry weight of cells	
		Intra-cellular	Extra-cellular
0	100	2·24	8·6
50	71·8	2·16	7·9
100	30·6	2·02	7·8

Folic acid activity was measured with *S. fœcalis* R as assay organism.

In view of this observation, alternate explanation had to be sought. An analysis of the culture filtrate of 2-Clp-ABA-inhibited cells showed that the added 2-Clp-ABA disappeared

from the growth medium, but could be recovered by acid hydrolysis with $0 \cdot 5$ M HCl at $100°$ C. for 1 hr. (Table II).

TABLE II

Metabolic fate of 2-Clp-ABA during the growth of O. malhamensis

2-Clp-ABA added to the medium μg. per ml.	Per cent. growth	2-Clp-ABA present in the medium after 7 days of growth μg. per ml.	
		Before hydrolysis	After hydrolysis
0	100	..	..
50	74·0	7·4	47
100	32·0	42·3	92
150	2·2	128·0	142

2-Clp-ABA was estimated by Bratton-Marshall reaction after deproteinising the culture filtrate with 10% trichloroacetic acid.

This is suggestive of some sort of binding of the amino group of 2-Clp-ABA. In this respect analogy could be drawn from the results of acetylation of *p*-ABA by animal liver observed by Harrow *et al.*[6] It was also reported that the acute toxicity of sulphanilamide could be alleviated to some extent by a process of acetylation.[7] This could be a possibility in the present case also. This supposition is further reinforced by reversal of growth inhibition due to *p*-ABA obtained with pantothenic acid during the present investigation.

On the basis of our observations it could be reasonably assumed that action of 2-Clp-ABA cannot be attributed to its interference in methionine synthesis alone. The acetylation of 2-Clp-ABA may be responsible for the growth inhibition, the acetylation mechanism in the organism being subjected to a greater strain, thus causing a depletion of acetyl CoA so vital for other metabolic functions of the organism. It seems 2-Clp-ABA has a preferential affinity to get acetylated rather than to compete with *p*-ABA in the biosynthesis of folic acid.

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CONFIGURATION EQUILIBRIA IN SOLUTION OF Ni (II) THIOMALIC ACID COMPLEXES

NICKEL (II) is known to form a deep violet coloured $1:3$ (metal : ligand) complex with thiomalic acid, $CH_2COOH.CHSHCOOH$ (at pH $9 \cdot 0 \pm 0 \cdot 2$).[1] Mathur and Nigam[2] have reported the effective magnetic moment value $2 \cdot 49$ B.M. at $28 \cdot 5°$ C. for this complex, whereas the value for an octahedral sp^3d^2 hybridised Ni^{2+} (d^8) complex is expected[3] to be $3 \cdot 2$–$3 \cdot 4$ B.M. In trying to explain the observed anomaly in magnetic behaviour, Mathur and Nigam are inclined to believe that the covalency factor[4] f^2 ($0 \cdot 78$ for the violet coloured complex of Ni (II) and $0 \cdot 92$ for the green ionic complex) might be responsible for quenching of magnetic moment.

In order to test the above points, the present authors have recorded the electronic spectra of this violet coloured complex in the range 1100–300 mμ (using Cary 14 recording spectrophotometer). The spectrum shows four bands at the positions $\nu_1 = 10337$ cm.$^{-1}$, $\nu_2 = 16053$ cm.$^{-1}$, $\nu_3 = 19802$ cm.$^{-1}$ and $\nu_4 = 29850$ cm.$^{-1}$.

Taking 10 Dq value of an octahedral field from the first band in this case and using Ballhausen's equations[6] the calculated bands are found to be 18594 cm.$^{-1}$ and 28296 cm.$^{-1}$, which are fairly close to the observed positions of the bands ν_3 and ν_4. The ratio of ν_3/ν_1 is equal to $1 \cdot 9$ which agrees with the theoretical value ($1 \cdot 8$) for an octahedral complex. Assignments of the bands may be made as :

$$(\nu_1) \ ^3A_{2g} \rightarrow \ ^3T_{2g}, \ (\nu_3) \ ^3A_{2g} \rightarrow \ ^3T_{1g}$$
$$\text{and} \ (\nu_4) \ ^3A_{2g} \rightarrow \ ^3T_{1g}(P).$$

However, the covalency factor as calculated[5] from spectral data comes out to be nearly $1 \cdot 1$ which clearly shows a completely ionic nature of the complex, and therefore the probability of covalency factor leading to a quenching in the magnetic moment, appears to be precluded. The planar form of Ni (II) complexes is known[7,8] to have an absorption maximum at about 16000 cm.$^{-1}$. Recently,[9–12] a good amount of work has been done on the configuration equilibria in solution of Ni (II) complexes. Further, some workers[9–11] have observed reduction in magnetic moment, due to simultaneous occurrence of octahedral or tetrahedral species along with square planar, in the solution of Ni (II) complexes. A more probable explanation may therefore be found in the presence of another diamagnetic square planar species in equilibrium with the octahedral one.

in the solution, which shows its characteristic
band at 16053 cm.$^{-1}$ arising out of the transi-
tion $^1A_{1g} \rightarrow {}^1B_{2g}$.

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ADRENERGIC MECHANISM IN *BORDETELLA PERTUSSIS* TREATED ANIMALS

PARFENTJEW AND GOODLINE[1] demonstrated that
mice treated with *Bordetella pertussis* vaccine
became hypersensitive to histamine. Later it
was seen that after such pretreatment both rats
and mice developed hypersensitivity to hista-
mine, 5-Hydroxytryptamine[3] (5-HT) or to
anaphylactic shock.[4] The mode of action of the
vaccine is not yet known. Recently it has been
suggested[5] that the vaccine produces blockade
of β-adrenergic receptors. Histamine is known
to cause liberation of adrenaline. In presence
of β-action blockade, the other actions of
adrenaline, (presumably α-actions), produce
disproportionate results with deleterious effects
on the organism. We have now tried to obtain
direct evidence of β-adrenergic blockade by
observing the actions of isoprenaline (which has
predominantly β-actions) in *B. pertussis* treated
animals.

Rats or mice received subcutaneously
200,000 10⁹ organisms in 1 ml.; rabbits or

guinea-pigs were injected with 1 ml. of the same
solution per Kg. body weight.

In guinea-pigs, 48 hours after inoculation, the
usual depressor response to isoprenaline was
changed to pressor and continued to be so for
the entire duration of study of 21 days. In the
rat, 1–17 days after injection, the depressor
response was reduced or abolished and only on
one occasion actual pressor response was
obtained. It was also seen that dichloroisopropyl
noradrenaline (DCI) which is supposed to be
a selective β-adrenergic blocking agent produces
similar changes in isoprenaline response.

In contrast to results in the guinea-pig and
the rat, there was no change in the pattern of
the response in the rabbit 1–23 days after inocu-
lation. But when the injection of the vaccine
or DCI was given intravenously in acute experi-
ments, the depressor response to isoprenaline
was changed to pressor within 10 minutes and
continued to be so for one hour, at the end of
which period, the experiment was terminated.

The relaxant effect of isoprenaline on rabbit
ileum was abolished 3–10 days after inoculation.
The antispasmodic action of isoprenaline was
studied on isolated guinea-pig ileum after
inducing spasm with histamine or acetylcholine.
In such preparations, the antispasmodic action
was seen to be absent 2–5 days after inoculation.

There was no alteration of the response to
isoprenaline of the guinea-pig vas deferens or
the isolated rabbit heart (Langendorff) at any
time after pretreatment with B-pertussis
vaccine.

A characteristic finding in the intact rabbit
was the fact that adrenaline-induced hypergly-
caemia was completely absent in animals pre-
treated with the vaccine 5 days before. This
action of adrenaline is presumed to be of β
type as this is produced by isoprenaline and is
blocked by DCI.[6]

It was thus seen that there is some evidence
to indicate a blockade of certain actions in the
vaccinated animals, though universal blockade
is not seen at all sites supposed to possess
β-receptors.

The importance of β-adrenergic blockade as
a possible mechanism in induction of anaphy-
lactic hypersensitivity by the vaccine was also
studied. Two types of experiments were per-
formed. In *B. pertussis* treated animals
sensitised to the antigen, attempts were made
to block the supposed predominant α-actions by
the use of specific blocking agents like phenoxy-
benzamine (dibenzyline). In other experiments
attempts were made to mimic the postulated

α-action predominance by using β-blocking agents like DCI or nethalide in animals sensitised to antigen alone a short time before challenge.

Fishel and others[5] had found that dibenzyline reduces histamine toxicity in *B. pertussis* treated mice. However, dibenzyline, used in several dose levels was ineffective in reducing the intensity of anaphylactic shock in rats and mice sensitised to antigen with the aid of *B. pertussis* vaccine.

In the second group of experiments, nethalide or DCI in doses in which they completely blocked β-actions of adrenaline failed to increase the intensity of anaphylactic shock in animals sensitised to antigen alone. Thus it was seen that the postulated mechanism of β-adrenergic blockade cannot explain the increase in anaphylactic sensitivity produced by *B. pertussis* vaccine, as more potent blockade produced by DCI or nethalide does not produce a similar state of hypersensitivity.

B-pertussis vaccine was kindly supplied by Glaxo Laboratories (India). DCI was received from Lilly (U.S.A.), Nethalide was received from ICI (England), and dibenzyline was obtained from SKF (England). These free gifts are gratefully acknowledged.

Dept. of Pharmacology,   SATISH ARORA.
Maulana Azad   R. K. SANYAL.
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SPOT DETECTION OF MOLYBDENUM THROUGH ITS EXTRACTION AS 1, 10 PHENANTHROLINE COMPLEX

A MODIFICATION to the spot test procedure for molybdenum developed by Moss and co-workers is suggested in this paper.[1] This involves the extraction of molybdenum as its 1, 10-phenanthroline complex into benzyl alcohol. The spot test procedure based on extraction not only stabilises the colour but also eliminates the intereference of several substances including coloured ions.

Procedure.—0·05 ml. of molybdenum (VI) solution is taken in a microtest-tube along with 0·1 ml. of 0·1% 1, 10-phenanthroline, 0·1 ml. of 5 M. sodium chloride, 0·08 ml. of concentrated hydrochloric acid and 0·12 ml. of water. 0·5 ml. of benzyl alcohol is added followed by 0·05 ml. of 1 N stannous chloride in 2 N hydrochloric acid. The contents are shaken for 30 seconds. A rose red colour in the organic phase indicates the presence of molybdenum.

The order of mixing the reagents is to be strictly followed. Particularly, the acid should not be added before the addition of 1, 10-phenanthroline, as otherwise no colour is developed.

Limit of Identification.—0·2 μg. of molybdenum in 0·5 ml. Dilution limit : 1 : 2·5 × 10^6.

Among various substances studied for their interference only Cu(II), W(VI) and Co(II) give coloured complexes under the experimental conditions.

Chemistry Dept.   V. PANDU RANGA RAO.
Andhra University,   K. VENUGOPALA RAO.
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A NOTE ON THE 'PRESSURE SHADOWS' IN THE CALCAREOUS PHYLLITE OF THE BUXA SERIES IN THE NORTH-EASTERN PART OF DARJEELING HIMALAYAS

THE Buxa group of rocks, which represents the uppermost part of the Daling Series, is composed chiefly of dolomite with intercalations of quartzite and calcareous phyllite. Though these rocks are tightly folded and are sheared at places, they are characterised by various types of sedimentary structures and penecontemporaneous deformation features. The calcareous phyllite occasionally contains small pyrite crystals, along the fringes of which 'pressure shadows', have developed. These pyrite crystals cut across the weakly preserved bedding (S_1) and the axial plane schistosity (S_2) which is normally sub-parallel to the former. Incidentally, 'pressure shadows', according to Pabst (1931),[1] is the name applied to the fringes or the halos that often accompany porphyroblasts in metamorphic rocks. The phyllite is composed

mainly of sericite and dolomite. The 'pressure shadows' are occupied by calcite and quartz.

The size of the pyrite grains varies from 1·3 mm. × 1·5 mm. to 0·4 mm. × 0·3 mm. The 'pressure shadows' are generally 'V'-shaped with the blunt sides on the faces of pyrite and the apices pointing in the direction of weakly developed schistosity (S_2). The size of the shadow zones ranges from 4·5 mm. × 1·5 mm. to 0·75 mm. × 0·40 mm., depending on the size of the pyrite face. Quartz in the 'pressure shadows' are feathery in nature with the length varying from 2·5 mm. to 0·60 mm. and gradually the grains become equant near the apices of the shadow zones. Quartz has a strong dimensional orientation in contrast to calcite, with the long axes perpendicular to the controlling pyrite face (Fig. 1). In cases where composite shadow

Fig. 1 'Pressure shadow' developed on the two faces of pyrite crystal (black). Note the dimensional orientation of quartz (white) and its variation in grain size. Calcite – ruled.

zones are developed on two adjacent faces of pyrite crystal, the quartz grains show two preferred directions of dimensional orientation, viz., (i) parallel to the schistosity (S_2) and (ii) perpendicular to the pyrite faces, which are athwart to S_2 (Fig. 2).

Fig. 2 'Pressure shadow' at the edges of pyrite crystal (black). Quartz – white, Calcite – ruled.

Chlorite, which is scanty in the rock, becmes increasingly abundant as the fringes of the 'pressure shadows' are approached. The phyllite is coarser in grain size in the vicinity of the 'pressure shadows' than away from it. The fracture cleavage (S_3) in the phyllite is manifested in the shadow zone by the elongation of minute quartz grains sub-parallel to it at the margins.

The origin of the 'pressure shadows' is yet to be clearly understood. Pabst (*loc. cit.*) considered them to be the result of extension in the host rock in the plane of schistosity which tended to pull the matrix from the sides of the porphyroblasts, the potential opening being filled continuously by quartz. This envisages some rotation of the porphyroblasts. The pyrite crystals in these phyllites apparently do not show any evidence of rotation. It is, therefore, suggested that after the growth of pyrite, the superincumbent pressure was responsible for creating stress-free zones at the fringes of the pyrite crystals in the direction of the schistosity, resulting in 'pressure shadows', where neo-crystallisation of calcite and quartz took place.

2, Rishi Bankim   SUBIMAL SINHA ROY.
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INTERRELATIONSHIP OF PHYTO- AND ZOOPLANKTON IN A FRESHWATER TANK

PLANKTONIC organisms show a variety of interrelationships between individuals of a species as well as between species. Of these, diurnal vertical migration of phyto- and zooplankton, in freshwater ponds, have been investigated by several workers. However, contributions from tropical regions are meagre and some of the recent investigations are those of Chacko *et al.* (1953, 1954),[1] Chakrabarty *et al.* (1958),[2] George (1961)[3] and Krishnamoorthy *et al.* (1963).[4]

This note deals with the interrelationship between phyto- and zooplankton populations in Mariamman Teppakulam, an artificial tank in Madurai. The tank is almost a perfect square, measuring 304·8 metres from North to South and 289·56 metres from East to West, having a maximum depth of 3·05 to 3·66 metres during the rainy season and 0·91 to 1·52 metres during summer. There is an artificial island in the centre, from which the study was made. A neat parapet wall is constructed around the tank and the central island. It is purely rainfed and the sewage of the town is let in occasionally.

Plankton collections were made at intervals of 3 hours for 24 hours, from 9 a.m. to 9 a.m. the following day. The samples were taken at the surface, 0·7 metres and 1·3 metres from the surface respectively, when the total depth of the water was only 1·5 metres. Temperature and

oxygen did not show any wide differences at the various depths, the maximum difference in the temperature being 1·5° C and in oxygen 0·2 ml./ litre at the time this observation was made. The pH of the water in the tank remained on the alkaline side (pH 9) with very little change during the period of observation.

Column 1, in Fig. 1, read from left to right, indicates the trend of total phytoplankton which shows an upward movement reaching maximum density at the surface at 3 p.m. This trend reverses between 6 p.m. and 12 midnight, after which once again the upward movement is repeated.

general pattern of total zooplankton but not so the population trend of *Microcystis*. The latter reaches its maximum at the surface by 9 a.m. and shows very rapid fluctuations in the mid-depth and bottom during the rest of the day. It is remarkable that in a matter of 3 hours (6 a.m. to 9 a.m., Column 4) the bulk of *Microcystis* population moves from the bottom and reaches the surface. Thus, there is evidence of clear vertical migration of plankton.

The total count of plankton at various depths shows further that they do not make up to the same total number at all times. Making allowances for mortality through predation or grazing

FIG. 1. Showing vertical migration of phyto- and zooplankton.

Column 2 represents the trend in total zooplankton population, showing a maximum between 9 p.m. and 12 midnight and by 3 a.m., the downward movement is well underway and the population thins out at all depths by 9 a.m.

As these two columns represent perhaps the mean trend of the entire phyto- and zooplankton population, they are at best the mean of vertical migration of the various species comprising the entire net plankton.

In order to elucidate the precise intrinsic relationship, the population of *Daphnia* (Column 3) and of *Microcystis* (Column 4) are displayed in Fig. 1. It is seen clearly in the presentation, that the Daphnid population follows the

and other causes, still the possibility of the plankton, particularly the zooplankton, taking shelter, in the bottom debris or at the water-soil interface at the bottom seems to be a natural means of escaping adverse conditions. Daphnid maximum (at all depths) at 9 p.m. is 9688/100 l but this dwindles to a mere 538/100 l or 118/ 100 l at 9 a.m. (Column 3). The discrepancy in number is very wide and obviously this is due to their moving to the bottom and behaving as benthic organisms. This is not true to the same extent in *Microcystis* and the time of maximum density also differs in the phytoplankton. The building up of *Microcystis* population between 6 a.m. and 9 a.m. (Column 4) bears

... relationship whatsoever to the total zooplank-
... minimum (9 a.m. to 3 a.m., Column 2) to
... any grazing effect. Hence, the oscilla-
... in the population of phyto- and zooplank-
... seem to be independent of each other.

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Dept. of Zoology,   SUMITRA VIJAYARAGHAVAN.
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ON A HITHERTO UNKNOWN METACERCARIA FROM A DRAGONFLY

Mishra and Pande (1967, 1967 *a*) have recently
reported from *Sympetrum decoloratum*, the
metacercaria of *Prosthogonimus putschkowskii*
Skrjabin, 1612 and two other metacercarial
forms with a lecithodendriid affinity. In an
earlier report, Hanumantha Rao and Madhavi
1961 had recorded that the naiads of the
dragonflies of the family Libellulidae harboured
the metacercariae of *Eumegacetes* sp.

From amongst a total of 1212 specimens of
dragonflies belonging to six species, two speci-
mens of an interesting metacercarial form,
described below under *Laterotrema*, were
recovered from a female specimen of *Crocothemis
servilia*.

The greenish-yellow, spherical cysts, with a
scarlet brown hue on the inner border, measured
0·339 mm. in diameter—the cyst wall being
0·12 mm. thick. One of the cysts was fixed in
10% formalin and preserved. A coverslip pre-
paration of the second, examined under the
microscope, exhibited the juvenile completely
filling up the space surrounding it. It exhibited
a spined cuticle, the two powerful suckers and
an extensively developed but somewhat oval
bladder. The bladder, full of black excretory
granules, occupied the greater part of the cyst
(Fig. 1).

The excysted juvenile carried spines mostly
in the preacetabular region and measured
0·841 mm. in length and 0·380 mm. in maxi-

mum breadth in the region of acetabulum.
The subterminal oral sucker was 0·150 mm. in dia-
meter; the prominent pharynx 0·067 × 0·051 mm.
in size; the short oesophagus of 0·015 mm. in
length; the intestinal cæca extended to near
the middle of the postacetabular region; and the
acetabulum, situated at about 3/4th of the body
length from the anterior extremity, measured
0·133 mm. in diameter. The excretory pore,
at the posterior end, opened into an extensive
Y-shaped excretory bladder which extended
beyond the acetabulum. The rudiments of the
two testes, rounded in form and lying just
behind the acetabulum, lay near the tips of the
intestinal cæca and measured 0·061–0·067 mm.
in diameter. The preacetabular ovarian rudi-
ment was present near the middle of the body
(Fig. 2).

FIGS. 1-3. Fig. 1. A cyst; Fig. 2. Excysted juvenile
(alive); Fig. 3. Excysted juvenlie (stained mount).

After fixation, the excysted form was stained
for a permanent mount which, in addition to
the symmetrically placed postacetabular rudi-
ments of the testes and the ovary lying laterally
in front of the acetabulum revealed the rudi-
ments of the cirrus sac on the side opposite to
that of the ovarian rudiment. The cuticular
spines were lost during processing. The follow-
ing measurements were taken : length 0·568 mm.;

maximum breadth at acetabular level 0·321 mm.; subterminal oral sucker 0·111 × 0·12 mm.; pharynx 0·047 × 0·063 mm; acetabulum 0·0105 mm. in diameter ; testes 0·037 × 0·032–0·047 mm.; ovary 0·024 mm. in diameter (Fig. 3).

The size of the suckers, the topography of the developing organs and the Y-shaped character of the excretory bladder suggested a stomylotrematid affinity. In the family Stomylotrematidae, the position of the testes—whether preacetabular or postacetabular has been used by Yamaguti (1958) in distinguishing the two subfamilies : Stomylotrematinæ and Laterotrematinæ. The testes, in Laterotrematinæ, lie posterolaterally to the acetabulum. On account of this position, the metacercaria is assigned to the single genus *Laterotrema*, under this subfamily.

From the bursa fabricii and cloaca of *Dicrurus macrocercus macrocercus,* Mehra (1938) first reported this genus and described his species *L. indianum.* The position of the ovarian rudiment, lying in front of the acetabulum, suggested that the metacercaria belonged to the subgenus *Laterotrema* s. str. as cited by Singh (1962) who has recently described a new species, under Yamaguti's subgenus *Pseudolaterotrema* raised by him to a generic rank, as *P. indica* from the intestine of Spotted Forktail, *Enicurus maculatus guttatus.*

Thanks are due to the Principal for facilities provided and the Director, Zoological Survey of India, Calcutta, for identification of the Dragonfly.

Department of Parasitology,   R. PRAKASAH.
U. P. College of Veterinary   B. P. PANDE.
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RADIATION-INDUCED DWARF MUTANT IN BARLEY

EXTENSIVE mutation work, both applied and fundamental, had been done using the cultivated species of barley (*Hordeum vulgare*). Many agronomically useful mutants have been induced and some of them are under cultivation in Sweden.[1,2] Most of the established Indian varieties of barley are suitable for cultivation under low fertility condition with or without irrigation. When such strains are grown under fertile conditions with regular irrigation, the vegetative growth is enhanced and the plants lodge prematurely leading to reduced grain yield. Hence, it is necessary to use varieties which can exploit the increased nitrogen fertilization and give high yields proportional to the increased inputs of manure and irrigation. Some years back a similar problem faced by wheat breeders was solved by the incorporation of dwarfing gene which lead to the evolution of high yielding Mexican wheats now under cultivation. In the case of barley, many of the induced dwarf mutants have some undesirable pleiotropic effect like reduced ears which affects the grain yield.[1,3,4]

The variety NP 13 is a popular 6-rowed barley strain grown in the Northern plains. Mutation work was started in this material at I.A.R.I. In 1964-65 a large M_2 population was raised for screening. True breeding, recessive, dwarf mutants were isolated from one M_2 line (X-ray 30 kr. treatment). The height of these mutants was much reduced and in one case it was only 50% of the control (parent). The number of ear-bearing tillers in these dwarfs was more than that of the control and the number of internodes per tiller was less in these mutants. The mean length of the ear-bearing internode was less. Thus the reduction in plant height had been brought about by the reduction in internode number and length of the ear bearing internode. The mean length of the mutants was comparable to that of the control. This indicates the absence of pleiotropic effect of the dwarfing gene on the ear character. In other features like heading time and maturity the mutant was similar to the parent. Some of the plant and ear characters of the mutant are compared with those of the control in Table I.

TABLE I

	Mean plant Height (cm.)	Mean No. of internodes per tiller	Mean length of ear-bearing internode (cm.)	Ear length (cm.) Range	Ear length (cm.) Mean
Control ..	85·0	7·0	23·2	5·3—6·2	5·8
Mutant ..	46·5	5·5	16·0	4·5—8·0	6·0

The seed fertility of the mutants was somewhat reduced in the first year but this was due to the shading effect of the tall plants in the row. When the dwarfs were grown in separate

... their seed-set was much improved.
However, the undesirable trait of the induced
... was that the development of ear-bearing
... was as much non-synchronous as it was
in the tall parent. Further selection and cross-
... are under progress to rectify this character.

I am grateful to Dr. M. S. Swaminathan for
... useful suggestions.

Division of Genetics,   R. KRISHNASWAMI.
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NEW RECORD OF *ENTOMOPHTHORA* SP. PARASITIC ON *RHOPALOSIPHUM MAIDIS* (FITCH) AND *LUCILIA CUPRINA* (WIDEMANN)*

R. palosiphum maidis (Fitch) is commonly found on maize and causes appreciable injury to the leaves and inforesence. In plains they are most abundant during the winter season and disappear with the advent of hot summer days. They again appear in noticeable numbers during the monsoon.

Maize (*Zea mays*) crop was surveyed in Pantnagar (District Nainital), Uttar Pradesh, in the year 1965. During the survey the attack of a fungus *Entomophthora* sp. was noticed on *Rhopalosiphum maidis*.

The colour of the diseased aphids changes to dark brown from green to bluish-green: the shrivelled body is another character of the disease. The dead specimens were dissected and mounted in Lectophenol cotton blue for microscopic examination of the pathogen.

This revealed the presence of conidia and hyphæ. The hyphæ were entomogenous and measured 10–14 μ in diameter. The conidia were unicellular, more or less papillate and measured 17–24 × 10–14 μ. Various organs were found in disintegrated condition and alimentary canal was also found full of conidia and hyphæ.

The fungus was identified as a species of the genus *Entomophthora* and is different from the two species of *Entomophthora* already recorded from India. This is the first record of a species of *Entomophthora* on *Rhopalosiphum maidis*.

Entomophthora aphidis has been recorded from India by Mathur and Srivastava (1966) on spotted alfalfa aphid. Hall and Dunn (1957) recorded the parasitization of alfalfa aphid by *Entomophthora exitialis* in India. *E. aphidis*

has also been recorded from India by Batra and Krishan Kumar (1961) on *Myzus persicæ*.

Lucilia cuprina (Widemann) occurring throughout India, sometimes causes cutaneous myasis in sheep.

The diseased specimens of *Lucilia cuprina* were collected from the District of Lucknow. On examination it was found to be parasitized by *Entomophthora* sp. The diseased specimen was of dark black colour. The conidia measured 17–28 × 10–15 μ. Conidia were papillate and thin walled. The conidia and hyphæ are present in abundance in the body. Marchionatto (1945) described the parasitization of *Lucilia cæser* by *Empusa americana*. The fungus was identified as *Entomophthora* sp. and this is the first record of the species of *Entomophthora* attacking *L. cuprina* in India.

The authors wish to thank Dr. S. Pradhan for facilities and Dr. M. G. R. Menon for identification of the aphid.

Division of Entomology,   S. B. MATHUR.
Indian Agricultural   R. P. SRIVASTAVA.
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CYTOLOGY OF *CYCAS BEDDOMEI* DYER

SIX species of *Cycas* have been reported from the Indian region by Raizada and Sahni,[1] of which *C. beddomei* Dyer is an endemic species restricted to the dry hills of Cuddapah and Chittoor Districts of Andhra Pradesh. Karyotype analysis has been carried out in *C. revoluta* Thunb., *C. circinalis* Linn. and *C. rumphii* Miq. by Sax and Beal,[2] and *C. pectinata* Griff. by Abraham and Mathew,[3] the somatic chromosome number reported in all the species being 22. Shetty and Subramanyam[4] also reported $2n = 22$ in *C. revoluta, C. circinalis* and *C. beddomei*. In the present note the details of the morphology of the chromosomes of *C. beddomei* are given.

The plants under investigation were collected from Thirupathi Hills in the Chittoor District

of Andhra Pradesh (voucher specimen No. *Subramanyam 6944.* MH) and grown in the Garden of the Botanical Survey of India, Coimbatore. For the study of somatic chromosomes root-tip squash technique was adopted for which root tips were pretreated with 0·002 M soluion of 8-hydroxyquinoline for 2½ hours at 10° C., fixed in acetic alcohol (1 : 3) for 12 hours, stained in leuco-basic fuchsin after hydrolysis in normal HCl for 20 minutes at 60° C. and squashed in propiono-carmine.

The diploid chromosome number is 22 (Fig. 1). The chromosomes are fairly long and can be classified as follows based on their size and position of the centromeres (Fig. 2).

FIGS. 1–2. Somatic chromosomes of *Cycas beddomei* × 1,730.

A. Three pairs of long chromosomes with submedian centromeres.

B. Five pairs of long chromosomes with subterminal centromeres.

C. Two pairs of small chromosomes with submedain centromeres.

D. One pair of small chromosomes with median centromeres.

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January 18, 1967.

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LEPTOSPHAERULINA TRIFOLII ON PASSIFLORA LESCHENAULTII AND MARSILEA QUADRIFOLIATA—TWO NEW HOST RECORDS FOR INDIA*

THE fungus *Leptosphœrulina trifolii* (Rost.) Petrak has a wide host range. Although originally described on clover as *Sphœrulina trifolii* Rostrup[9] the fungi corresponding to the description *Leptosphœrulina* have been variously

named : *Pseudoplea trifolii* (Rost.) Petrak,[6] *Pleospora trifolii* (Rost.) Petrak,[7] *Pseudosphœria trifolii* (Rost.) Höhnel[4] and *Saccothecium trifolii* (Rost.) Kirschstein.[5] In 1959 Petrak[8] suggested a new combination for this fungus, *Leptosphœrulina trifolii* (Rost.) Petrak. Species of *Leptosphœrulina* occurring on forage plants were revised by Graham and Luttrell.[3] Corbett[2] recorded the fungus as *Pseudoplea (Leptosphœrulina) trifolii* on egg-plant from Nyasaland during 1961–62. A severe attack of red clover burn due to *L. trifolii* was reported in 1963 from New South Wales, Australia (Anonymous[1]). In India, Satya and Rajalakshmi[10] reported it on *Cassia obtusifolia*, *C. tora* and *C. absus* from Bhopal during August 1963. *Leptosphœrulina trifolii* is also referred to as *L. briosiana* (Poll) Graham and Luttrell by some authorities, and immature collections have also been described under *Pringsheimia* (C. Booth, *in litt.*).

While the previous records have been mostly on members of Leguminosæ, and in isolated cases on Solanaceæ, the same fungus is here reported for the first time on plants of two different families, *viz.*, *Passiflora leschenaultii* (Passifloraceæ) and *Marsilea quadrifoliata* (Marsileaceæ). The characteristics of this fungus from these present collections are given below :

(i) ON *Passiflora leschenaultii* DC.

Spots amphigenous, circular to oval, coalesce to form large patches 2–5 mm., with light-yellow periphery and sunken reddish-brown centres. Ascocarps brown to dark brown, scattered over the infected region occasionally in groups, amphigenous, round to globose, pseudoparenchymatous, immersed with an irregular ostiole 120–200 μ. Asci in basal layers aparaphysate, bitunicate, octosporous 56–110 × 30–45 μ. Ascospores oblong, muriform with 4–6 transverse septa and 0–4 oblique or vertical septa, brown to light brown 22–48 × 12–20 μ. Ascospores germinate readily on malt or potato dextrose agar and form stromatic ascocarps with mature asci and spores in 10–14 days (Fig. 1). No conidial state has been observed.

On living leaves of *Passiflora leschenaultii* DC. (Passifloraceæ) 26-11-1963 Miss P. K. Machie, Murnad-Coorg (Mysore State), Herb. IMI 103594.

(ii) ON *Marsilea quadrifoliata* LINN. (FIG. 2)

Spots rusty brown with a light-yellow periphery turning dark brown as the disease progresses, measuring 12–20 mm., amphigenous,

... ...fined to the margin of the leaflet,
...... various shapes. Ascocarps brown to
.... scattered or gregarious, sub-
...... round to globose, pseudoparenchy-
...... and ostiolate. 72–128 μ. Asci in basal
...... paraphysate, bitunicate, octosporous,
...... 14–84 ... Ascospores oblong, muriform
...... three transverse septa and 0–2 oblique
.... brown to light brown $20 \cdot 46 - 26 \cdot 04 \times$
.... No conidial state has been observed.

FIG. 1. *Leptosphaerulina trifolii* on *P. leschenaultii*.
Section through ascocarps from 14-day culture.

FIG. 2. *Leptosphaerulina trifolii* on *M. quadrifoliata*.
A. Ascus. B. Ascospores.

On living leaves of *Marsilea quadrifoliata*
Linn. (Marsileaceæ), 22-12-1965. K. M.
Ponnappa, Yelahanka (Bangalore). Herb. IMI
117749.

A careful review of mycological literature
... that there is no previous record of this
... and the fungus causing it from India

on *Passiflora leschenaultii* and *Marsilea quadri-foliata*.

Commonwealth Institute of   K. M. PONNAPPA.
Biological Control,
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January 16, 1967.

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by the United States Department of Agriculture under
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SCLEROTIAL FORMATION BY *CURVULARIA PALLESCENS**

A NUMBER of fungi are reported to form
sclerotia [2,5,7] which serve as organs of spread
and survival in soil. Although cellulose is an
abundantly available substrate in soil, little is
known concerning its nutritional influence on
sclerotial formation. The ability of seven
species of *Curvularia* to utilise cellulose and
form sclerotia in the presence of organic and
inorganic nutritional supplements is reported
here.

Curvularia pallescens Boed., *C. lunata* (Wakk.)
Boed., isolated from the rhizosphere soil of rice,
C. oryzæ Bugni., *C. fallax* Boed., *C. cymbopogonis*
(Dodge) Groves and Skolko, *C. spicata* (Bain.)
Boed., *C. brachyspora* Boedijin obtained from
the Centraalbureau voor Schimmelcultures
Baarn (Netherlands), were grown on laboratory

agar media, on treated bacterial and plant cellulose and in soil amended with sucrose (1%), glucose (0·5%), oats, rice leaves, stubbles and filter-paper. Fluted Whatman No. 1 paper with 1-in. rings cut out in the centre were immersed singly in 50 ml. Richard's solution in 250 ml. conical flasks. Bacterial cellulose obtained from *Acetobacter xylinum* (Brown) Holland was used by treating in Richard's solution as well as by substituting the nitrogen level with sodium nitrate, ammonium sulphate, ammonium nitrate, ammonium chloride and ammonium phosphate. Root exudates of rice (MTU 9) were collected following the method of Andal *et al.*[1] and used as nitrogen source in these studies.

filter-paper. At least for *C. lunata* Tullis[6] and Marchionatto[4] arrived at the same conclusions. Similarly, none of the other five species of *Curvularia* formed sclerotia on any one of the above media.

It is suggested from these results that *C. pallescens* and *C. lunata* are better adapted for saprophytic survival as well as to increase their inoculum potential as compared to other species of the genus. These results are apparently valuable in the light of the report by Forsberg[3] who attributed a parasitic role to *Curvularia lunata* as a vascular pathogen.

I am thankful to Professor T. S. Sadasivan for suggestions, to Dr. J. Ross Colvin, Division of Applied Biology, National Research Council,

FI . 1. Sclerotia and conidia of *Curvularia pallescens* on bacterial cellulose. A. Linear sclerotia, × 80. B. Linear sclerotia with conidia, × 400. C. Normal sclerotia with conidia, × 600.

Sclerotia of *Curvularia pallescens* and *C. lunata* were observed on bacterial cellulose impregnated in Richard's solution and substituted with sodium nitrate, potassium nitrate, ammonium nitrate and ammonium chloride buffered with succinic acid. On organic substrates like rice grains, rice leaves or on soil enriched with oats (20%), glucose (0·5%), sucrose (1%) and rice stubbles percentage of sclerotia increased, in addition to the formation of linear sclerotia (3 to 6 inches) resembling rhizomorphs (Fig. 1, A and B) on glucose- and sucrose-enriched soil. Root erudates as nitrogen source induced sclerotia (Fig. 1, C) and conidia in the presence of bacteria cellulose. Other species of *Curvularia* used in these studies failed to form sclerotia under the same conditions.

Sclerotia of *C. pallescens* and *C. lunata* were not formed on common laboratory agar media (Richard's, Czapek's, starch, oat meal or soil extract agar), on sterilised soil or on fluted

Ottawa (Canada), for the culture of *Acetobacter xylinum* and to the Government of India for the award of a fellowship.

Centre of Advanced   T. K. RAMACHANDRA REDDY.
  Studies,
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REVIEWS AND NOTICES OF BOOKS

Silicate Science (Vol. 4). *Hydrothermal Silicate Systems.* By Eilhelm Eitel. (Academic Press, Inc., New York and London), 1966. Pp. xiv + 617. Price $ 24.00.

Volume 4 of this well-known series is dealt with in two sections. Section A: Silicate Systems with Volatiles contains the following articles: Gas Absorption in Fused Silicates; Silicate Systems with Volatile Components; Introductory Remarks; The Role of Water in Volcanic Phenomena; Metasomatosis. Problems of Migmatites and Granitization; Geothermal Significance of Gas-Liquid Inclusions in Minerals: Pneumatolytic and Pegmatitic Mineralization: Participation of Silica and Silicates in Heterogeneous Gas Reactions; Systems of Silicates with Fluorides in Melts: Carbonate-Silicate Systems; High-Pressure Apparatus; Hydrothermal Synthesis, General: Hydrothermal Syntheses and Equilibria: System Silica-Water; Growth of Quartz Monocrystals: System Water-Silica-Sodium Oxide: System Water-Silica-Magnesia; System Water-Silica-Calcium Oxide; The System Water-Silica-Calcium Oxide, Alkalies (Na_2O, K_2O): The System Water-Silica-Calcium Oxide-Magnesium Oxide; The System Water-Silica-Strontium Oxide; The System Water-Silica-Barium Oxide; The System Water-Silica-Manganous Oxide; The System Water-Silica-Iron Oxides (FeO and Fe_2O_3); The System Water-Silica-Nickel Oxide (and Magnesia): The System Water-Silica-Zinc Oxide; The System Water-Silica-Alumina; The System Water-Silica-Alumina-Alkalies; System Water-Silica-Alumina-Potassium Oxide, Rubidium and Cesium Oxide; The System Water-Silica-Alumina-Potassium Oxide-Sodium Oxide: The System Water-Silica-Alumina-Magnesia: The Systems Water-Silica-Alumina-Magnesia-Lithium or Sodium Oxide; The System Water-Silica-Alumina-Magnesia-Potassium Oxide: The System Water-Silica-Alumina-Calcium Oxide: The System Water-Silica-Alumina-Calcium Oxide-Alkalies; The System Water-Alumina-Magnesis-Calcium Oxide; The System Water-Silica-Iron Oxides; Problems of Spilitization: Hydrothermal Experimentation on Metamorphism of Sediments; System Water-Silica-Titanium Dioxide, and Related Systems; Systems Water-Silica-Zirconium, Uranium (IV), and Thorium Dioxide, and Related Systems;

Water-Containing Natural Glasses; Investigations of the Chemical Weathering Process; Soluble Silicates: Their Constitution and Physicochemical Characteristics; The System Water-Silica-Calcium Oxide at Low Temperatures; Solubility of Silicate Glasses.

Section B: Dehydration Behavior of Silicate Hydrates: Zeolites and Related Materials contains the following articles: Origin of Natural Zeolites; General Physicochemical Characteristics of Zeolites; Sorption of Zeolites: Molecular Sieve Effects on Microframeworks; Crystallographic-Chemical Destruction and Regeneration of Zeolites; Base Exchange Reactions in Zeolites and Related Minerals and in Synthetic Materials; Ion Exchange Reactions on Gels, Cryptocrystalline Aluminosilicate Hydrates and Related Materials.   C. V. R.

Annual Review of Nuclear Science (Vol. 16). Edited by Emilio Segre. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306, U.S.A.), 1966. Pp. v + 671. Price $ 8.50 per copy (U.S.A:) and $ 9.00 (elsewhere).

This volume under review contains the chapters listed below: Modes of Radioactive Decay Involving Proton Emission, by V. I. Goldanskii; Chemical and Structural Effects on Nuclear Radiations, by Sergio DeBenedetti, Fernando deS.Barros, and Gilbert R. Hoy; Thermal Equilibrium Nuclear Orientation, by David A. Shirley; Isobaric Spin in Nuclear Physics, by D. Robson; Quasi-Free Scattering, by Tore Berggren and Helge Tyren; Fluctuations in Nuclear Reactions, by T. Ericson and T. Mayer-Kuckuk; Production and Use of Thermal Reactor Neutron Beams, by H. Maier-Leibnitz and T. Springer; Regge Poles, by Roland L. Omnes; Energetic Particles in the Earth's Magnetic Field, by Kinsey A. Anderson; Economics of Nuclear Power, by James A. Lane; Nuclear Fission, by J. S. Fraser and J. C. D. Milton; Muonium, by Vernon W. Hughes; Weak Interactions (Second Section), by T. D. Lee and C. S. Wu; Chapter 8: Decays of Charged K Masons; Chapter 9: Decays of Neutral K Meson; Neutrinos in Astrophysics and Cosmology, by Hong-Yee Chiu; On-Line Computer Techniques in Nuclear Research, by S. J. Lindenbaum.   C. V. R.

Annual Review of Entomology (Vol. 11). Edited by R. F. Smith. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California), 1966. Pp. vii + 596. Price $ 8.50 (U.S.A.) and $ 9.00 (elsewhere).

The scope of this book is indicated by the titles of the chapters given below : Regulation of Gene Action in Insect Development ; The Comparative Embryology of the Diptera ; Polymorphism in Aphididae ; Physiology of Caste Determination ; Insect Walking ; The Behavior Patterns of Solitary Wasps ; The Utilization and Management of Bumble Bees for Red Clover and Alfalfa Seed Production ; The Competitive Displacement and Coexistence Principles ; Insects in the Epidemiology of Plant Viruses ; A Functional System of Adaptive Dispersal by Flight ; Ticks in Relation to Human Diseases Caused by Viruses ; The Biosystematics of Triatominae ; The Use and Action of Ovicides ; Mode of Action of Insecticides ; Chemical Insect Attractants and Repellents ; Fungal Parasites of Insects ; The Role of Vertebrate Predators in the Biological Control of Forest Insects ; Management of Insect Pests ; Tea Pests and Their Control ; Pest Control.

C. V. R.

Phonons in Perfect Lattices and in Lattices with Point Imperfections. Edited by R. W. H. Stevenson. (Oliver and Boyd, Edinburgh and London), 1966. Pp. xiv + 448. Price 6 £ 6 *sh.*

This volume, the sixth in the series, contains the papers presented at the Scottish Universities' Summer School in Physics, 1965. After a general introduction by Professor C. Kittel (California), the papers are divided into two main subjects. In the first, vibrations in perfect lattices are discussed by W. Cochran (Edinburgh), W. A. Harrison (General Electric), B. M. Brockhouse (McMaster), W. Cochran and T. Smith (Edinburgh), R. A. Cowley (Chalk River), and H. Bils (Frankfurt), with contributions by T. Smith, J. P. Russell, J. R. Hardy and E. G. S. Paige.

In the second part vibrations in lattices with point imperfections are considered by G. H. Dieke (Johns Hopkins), D. S. McClure (Chicago), R. J. Elliott (Oxford), and M. H. L. Pryce (California). The material presented in the second part is particularly relevant to current studies on the vibrational structure of optical absorption by defects.

The Director of the 1965 Summer School was Professor C. W. McCombie of the University of Reading.

The Editor of this volume, Dr. R. W. H. Stevenson, is Senior Lecturer in Natural Philosophy, University of Aberdeen. C. V. R.

Annual Review of Physical Chemistry (Vol. 17). Edited by Henry Eyring. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California, U.S.A.), 1966. Pp. vii + 587. Price $ 8.50 per copy (U.S.A.) and $ 9.00 per copy (elsewhere).

Volume 17 of this well-known series contains the following articles : Prefatory Chapter : The First 45 years of Physical Chemistry in Germany ; Themodynamics ; Quantum Chemistry ; Statistical Mechanics : A Study of Intermolecular Forces ; Chemical Phenomena at High Temperature ; The Kinetics of Inorganic Reactions in Solution ; Gas Kinetics ; Radiation and Photochemistry ; Spin Excitations in Ionic Molecular Crystals ; Chemical Application of Mossbauer Spectroscopy ; Atomic Processes at Solid Surfaces ; Electron Spin Resonance ; Physical Organic Chemistry ; Solutions of Non-electrolytes ; Magnetic Optical Activity ; Dielectric Polarization and Relaxation ; Electronic Spectra of Organic Molecules ; Electrolyte Solutions : Solvation and Structural Aspects.

C. V. R.

Physical Principles of Magnetism. By F. Brailsford. (D. Van Nostrand Company Ltd., London), Pp. 274. Price not given.

The book presents a complete account of magnetism to meet the requirements of graduate students of science or engineering or metallurgy. It gives a unified treatment of the subject and includes the following topics : electronic structure of atoms, ionic crystal structure, diamagnetism and paramagnetism, ferromagnetism and antiferromagnetism, magnetic anisotropy, ferrimagnetism and technological aspects of magnetism. The paperback edition puts the book within the reach of students. A library edition in full cloth boards is also available.

A. S. G.

Elements of Thermodynamics. By D. ter Haar and H. Wergeland. (Addison-Wesley Publishing, Co., Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. 160. Price $ 7.00.

This theoretical text-book for graduate students deals with classical thermodynamics. The treatment follows a phenomenological

approach and deals with the following topics : First and Second Laws of Thermodynamics, Equilibrium. The Third Law, Isothermal Atmotions. Systems of Variable Mass, Chemical Equilibrium, The Third Law, Isothermal Atmosphere, and Chemical Equilibrium in the Gravitational Field. The text also contains many problems with solutions.   A. S. G.

The Gaseous State. By N. G. Parsonage. Pergamon Press, Ltd., Headington Hill Hall, Oxford). Pp. 170. Price 18 sh. 6 d.

This is an introductory book on the kinetic theory of gases and is chiefly concerned with the interpretation of the bulk properties of gases (the macroscopic properties) in terms of the characteristics of the constituent molecules. The chapters include the gas equation, velocity distributions and collisions, viscosity, conductivity, diffusion, Brownian movement and Avogadro's number, and energy transfers.

The lucid treatment can easily be followed by undergraduate students without much outside help.   A. S. G.

Precis of Special Relativity. By O. Costa de Beauregard. (Translated by B. Hoffmann). (Academic Press, New York and London), 1966. Pp. 123. Price $ 5.75.

This little publication is a condensed version of the author's treatise La Theorie de la Relativite Restreinte published in 1949. In making the condensation basic explanations have been fully retained, and the axe has been applied only to the details of calculations. As Professor J. A. Wheeler has pointed out in the Preface to this edition, "The space-time point of view today has become as natural a part of the thinking of the student of physics as Euclidean geometry was to the student of an earlier age. Its perspectives provide indispensable working tools".

For those who will have to work with these tools this book, with its precise treatment and clarity of expression, will provide a useful introduction.

In five chapters of about 10-15 articles each, the text covers all important non-spinorial-aspects of the special relativity theory, and include relevant topics in kinematics and optics, relativistic electromagnetism, relativistic dynamics, and analytical dynamics.   A. S. G.

Useful Plants of Brazil. By W. B. Mors and C. T. Rizzini. (Holden-Day Inc., 500, Sansome Street, San Francisco), 1966. Pp. 166. Price $ 11.00.

The book gives a summary account of established knowledge on the plants of Brazil. Descriptions of plants are given in brief and their uses mentioned. The plants include latex-yielding plants, wax-producing plants, coffee, spices, dye plants, medicinal plants, cork supplying plants, etc. This publication will fill a gap in botanical literature, and it will interest not only scientists but also industrial enterprisers.   A. S. G.

Books Received

Deformation and Strength of Materials. By P. Feltham. (Butterworth and Co., P. Ltd., 88, Kingsway, London W.C. 2), 1966, Pp. vii + 135. Price 25 sh.

Fuel Calorimetry. By B. Pugh. (Butterworth and Co., P. Ltd., 88, Kingsway, London W.C. 2), 1966. Pp. ix + 186. Price 28 sh.

General Entomology for Agricultural Students. By H. L. Kulkarny. (Asia Publishing House, Bombay-1), 1966. Pp. xv + 291. Price not given.

Chemotaxonomic der Pelanzen. By R. Hegnaur. Band 4—Dicotyledoneæ Daphniphyllaceæ Lythraceae. (Birkhauser Verlag, Basel, 4,000 Basel 10), 1966. Pp. 551. Price SFR 106. '

Blood Groups of Animals. Edited by J. Matousex. (Dr. W. Junk, Publisher, 13, van Stolkweg, The Hague, The Netherlands), 1965. Pp. 498. Price $ 6.95.

Stream Flow—Measurements Records and Their Uses: By N. C. Grover, A. W. Harrington. (Dover Publications, Inc., New York), 1966. Pp. xxiii + 363. Price $ 2.25.

Elements of Organic Chemistry. By A. H. Corwin and M. M. Bursey. (Addison–Wesley Publlishing Co., Reading, Mass.), 1966. Pp. xviii + 746. $ 9·50.

Elements of Thermodynamics. By D. ter Haar, H. Wergeland. (Addison-Wesley Publishing Co., Reading, Mass.) 1966. Pp. xiii + 160. Price $ 7.00.

CARNEGIE INSTITUTION OF WASHINGTON: YEAR BOOK 65*

THE current Year Book, covering the period from July 1, 1965 to June 30, 1966 contains President Caryl P. Haskins' Report to the Trustees, comprehensive reviews of work in progress in the various research departments of the Institution, a list of officers and staff, administrative reports, articles of incorporation, and by-laws.

The Department of Terrestrial Magnetism reports its varied activities ranging from mathematics and computer studies, through several problems connected with geophysics and astrophysics, astronomy, nuclear physics, and on to basic programs in biophysics and micro-biology.

The Geophysical Laboratory and the Department of Terrestrial Magnetism have co-operated for a number of years on a programme of rock dating by isotopic analysis of U/Pb, Rb/Sr and K/Ar systems found in minerals. This year the group attacked the problem of "continental drift" by the geochronological approach. The continental drift hypothesis, which has postulated that the existing continents were once a single land mass that split and separated into the present configuration, has gone through several cycles of acceptance and rejection. Because of the technique of palaeomagnetism which has provided a new tool, interest in the hypothesis has been revived within the last decade.

A favourite example of the continental drift hypothesis is to translate South America eastward to fit under the bulge on the west coast of Africa. Recently, the age of a persistent Precambrian rock belt, stretching east-west across South Africa at about latitude 30° S, has been determined as about 1000 million years. If South Africa and South America were once part of a single continent, the extension of the African belt should exist somewhere in the corresponding part of South America, i.e., coastal Uruguay and Argentina. Age determinations by the geochronology group during the year of the rock units in these areas believed to be orginally opposite coastal areas of South Africa, show them to be between 1700 and 2200 million years. This fails to give encouraging support to the continental drift theory, though it cannot be taken as disproving it.

The report of Mount Wilson and Palomar Observatories contains measurements during the year of "red shifts" of new quasi-stellar sources, observed with the 200-inch. Included in this is the largest red-shift yet found, namely the quasar designated 1116 +12, with the value of $\Delta\lambda/\lambda_0 = 2 \cdot 118$. The report from this department also exhibits two remarkable solar photographs obtained during the year. The one shows the solar granulations on a small part of the sun, taken with the 150-ft. tower telescope. The other is a high dispersion spectrogram which brings out with exceptional clarity the differential velocities of the solar granules as revealed by the "wiggles" of the absorption lines brought about by Doppler effect. It has been estimated that the lifetime of individual granules is about 8 minutes.

The Plant Biology Department reports a remarkable effect of oxygen on photosynthesis in leaves. It was found that a 50% increase in the rate of photosynthesis of leaves of higher plants took place when the oxygen of the surrounding air was replaced by nitrogen, without changing the CO_2 pressure. This inhibition of photosynthesis by oxygen may have some significance to photosynthetic productivity in nature. This effect was high in higher plants, but completely lacking in algæ.

Progress of work on nucleic acid metabolism is reported by the Department of Embryology. One group has been filling in fundamental data on accumulation and rates of synthesis of the various classes of nucleic acids in successive developmental stages of the clawed toad *Xenopus lævis*.

The peculiar internal structure of lambda DNA and its relation to some of its functions continued to interest a group of the Genetic Research Unit. Results of study show that the right and left ends of the lambda DNA molecule differ by about 10 percentage units in GC (guanine-cytosine) content.

The basic structure of the chromosomes in higher organisms is a fundamental problem which still awaits a satisfactory solution. The simple explanation that one single DNA double helix per chromatid meets the conditions required for expression of the genetic code and the response of the chromosomes to mutagenic agents, has been found to be inadequate. For one thing, it ignores the complex organisation of the chromosome, which includes not only DNA, but also RNA, histones and non-histone proteins. The report of the Cytogenetics Laboratory on Chromosome Organization in Eucaryotes points out the need for more precise cytological, cytochemical and genetic data which will lead to a fuller understanding of chromosome organization at the molecular level including DNA, RNA and other associated constituents.

THE CRYSTAL AND MOLECULAR STRUCTURE OF PHENYL HYDRAZINE (C$_6$H$_5$.NH.NH$_2$)

S. SWAMINATHAN AND S. SRINIVASAN

Department of Physics, Indian Institute of Technology, Madras-36

PHENYL hydrazine (C$_6$H$_5$.NH.NH$_2$) (Fig. 1) is a liquid at room temperature solidifying at 19° C. The unit cell dimensions and space group of this substance were determined by S. Ramaseshan at the Polytechnic Institute of Brooklyn, U.S.A., from Weissenberg and precession X-ray diffraction photographs of single crystals grown by the Fankuchen (1949) method. In this laboratory the crystal was again grown *in situ* on a Weissenberg goniometer by the method developed by Singh and Ramaseshan (1964) and the three-dimensional data were collected using Cu K$_\alpha$ radiation.

FIG. 1

The X-ray diffraction photographs gave the following data:

Space group P 2$_1$/c.

unit cell dimensions:

$a = 9.59 \pm 0.02$ Å
$b = 5.91 \pm 0.02$ Å
$c = 12.32 \pm 0.02$ Å
$\beta = 118° \pm 0.5°$

density (liquid) $= 1.0978$ gm. cm.$^{-3}$
density (crystal) calculated $= 1.1340$ gm. cm.$^{-3}$
number of molecules per unit cell $= 4$.

The structure analysis was taken up with the $h0l$, $h1l$, $h2l$ and $h3l$ Weissenberg equiinclination data. The structure was solved first in the (010) projection. A (010) Patterson projection gave only the projection co-ordinates of the ring centre without any other information about the orientation of the molecule. The Patterson map was modified to remove the origin peak and the ring-to-ring vector peak, and $\hat{f}$ sharpened and this enabled the orientation of the molecule to be fixed. The structure in projection was refined by trial and error and difference synthesis till the R factor fell to 0.25.

Lacking data in another projection, the approximate values of the third co-ordinates (the y co-ordinates) were obtained by packing considerations, assuming the standard intermolecular contact distances. These were adjusted to fit the $h1l$ data and later the hkl data ($k = 0$, 1, 2 and 3) till the overall R factor came to 0.24. The co-ordinates and temperature factors were then refined by four cycles of least squares refinement on the CDC 3600 computer at the Tata Institute of Fundamental Research, Bombay. The final R factor is 0.16. The atomic co-ordinates with the individual isotropic temperature factors are given in Table I, the interatomic bond lengths and the bond angles in Table II and the intermolecular contacts in Table III.

TABLE I

Fractional atomic co-ordinates and isotropic temperature factors

	x	y	z	(Å^2)
C$_1$	0.136	0.795	0.321	3.72
C$_2$	0.122	0.719	0.428	4.47
C$_3$	0.192	0.517	0.484	3.35
C$_4$	0.284	0.374	0.443	2.93
C$_5$	0.299	0.451	0.335	2.84
C$_6$	0.227	0.657	0.278	2.90
N$_1$	0.376	0.314	0.285	3.21
N$_2$	0.481	0.127	0.355	3.34

TABLE II

Interatomic distances and angles

Lengths	Values in Å	Angles	Values in degrees
C$_1$–C$_2$	1.45±0.04	C$_1$–C$_2$–C$_3$	120±1
C$_2$–C$_3$	1.38±0.03	C$_2$–C$_3$–C$_4$	121±2
C$_3$–C$_4$	1.45±0.04	C$_3$–C$_4$–C$_5$	119±1
C$_4$–C$_5$	1.45±0.04	C$_4$–C$_5$–C$_6$	118±2
C$_5$–C$_6$	1.40±0.03	C$_5$–C$_6$–C$_1$	120±1
C$_6$–C$_1$	1.46±0.04	C$_4$–C$_5$–N$_1$	121±1
C$_5$–N$_1$	1.42±0.03	C$_6$–C$_5$–N$_1$	120±1
N$_1$–N$_2$	1.46±0.04	C$_6$–N$_1$–N$_2$	121±2

TABLE III
Shortest intermolecular contacts (Å)

I	molecule at	x	y	z
II	,,	$\bar{x}$	$1/2+y$	$\bar{z}$
III	,,	$1-x$	$1/2+y$	$\bar{z}$
IV	,,	$1-x$	$1-y$	$1-z$

$N_1(I)-N_2(III)$	3·17
$C_3(I)-N_2(IV)$	3·56
$N_2(I)-C_3(IV)$	3·67
$C_1(I)-C_6(II)$	3·70
$C_1(I)-C_2(II)$	3·71
$N_2(I)-N_2(III)$	3·79

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GAMMA-GAMMA ANGULAR CORRELATION IN W^{182}*

P. C. MANGAL AND P. N. TREHAN
Department of Physics, Panjab University, Chandigarh-14, India

THE level structure of tungsten W^{182} has been investigated by a number of workers.[1,2] The spin of various levels and multipolarity of various gamma-rays have been determined, both by internal conversion method[3-5] and by gamma-gamma angular correlation measurements.[6-8] Due to the complexity of the level structure of W^{182}, shown in Fig. 1, it is found that some of

LEVEL SCHEME OF W^{182}

FIG. 1

the results obtained from these measurements are inconsistent. In particular Hickman and Wieldenbeck[6] has assigned a spin 4 to 1554 Kev level on the basis of the angular correlation measurements of 222–1231 Kev cascade. In doing so, they have assumed 1231 Kev gamma-

ray to be pure E_2 and 222 Kev gamma-ray to be pure E_1 in character, as determined by Murray *et al.*[3] from the internal conversion measurements. Whereas more recently Korkman and Backlin[5] have reported, from internal conversion measurements, that 1231 Kev gamma-ray is an admixture of E_2 and M_1, dipole component being of the order of $29 \pm 8\%$. In view of this discrepancy, it was thought worthwhile to study the angular correlation of 68–1222, 264–68 and 222–1231 Kev cascades in order to establish the spin 1289, 1331 and 1554 Kev levels and thereby determine the multipolarity of 1231 Kev gamma-ray from angular correlation measurements.

Measurements and Results.—The measurements were carried out with a conventional fast-slow coincidence arrangement with an effective resolving time of about 70 n-secs and two 3″ × 3″ NaI(Tl) crystals. The source was used in liquid form in order to minimise any electric quadrupole interaction. The coincidence data was taken with a 256 channel analyser to precisely assess the Compton contribution in the low energy region because of the high energy gamma-ray cascades. The gate was set at about 30 Kev higher than the composite photopeak of 1222–1231 Kev gamma-rays, with a window of 70 KeV, in order to avoid any interference because of 1122 Kev gamma-ray. In this way 68–1222 and 222–1231 Kev cascades could be run simultaneously. 264–68 Kev cascade was run separately with single channel analysers. The results of these measurements are as follows :

68–1222 Kev Cascade.—In this correlation, at each angle, the Compton component of 100, 151

and 222 Kev gamma-rays and any other weak low energy gamma-ray falling in coincidence with 1222 or 1231 Kev gamma-rays, was subtracted by peeling off method. The K X-ray component because of the low energy gamma-rays falling in coincidence with 1222 and 1231 Kev gamma-rays was estimated to be 33%. After making these two corrections and the finite solid angle correction, the measured coefficients come out to be:

$A_2 = 0.284 \pm 0.008$
$A_4 = 0.002 \pm 0.010$

These results are in agreement with the theoretical results of 2 (Q) 2 (D) 0 sequence for 68–1222 Kev cascade. Consequently a spin 2 is established for 1289 Kev level.

264–68 Kev Cascade.—The correlation for 264–68 Kev cascade was corrected for the contribution due to the coincidences between 68 Kev gamma-ray and the Compton portion of high energy gamma-rays falling in 264 Kev gate. This component was measured by shifting the 264 Kev channel gate to a higher side by about 150 Kev and was found to be 47%. The measured coefficients after finite solid angle correlation are:

$A_2 = 0.073 \pm 0.006$
$A_4 = 0.001 \pm 0.002$

These results are in good agreement with a 4 (Q) 2(D)2 sequence for 264–68 Kev cascade thereby establishing a spin 4 for 1554 Kev level.

222–1231 Kev Cascade.—In this measurement, 264–1222 Kev was the only interfering cascade. Its contribution was subtracted by peeling off method. The measured coefficients after solid angle correction, are:

$A_2 = -0.017 \pm 0.011$
$A_4 = 0.008 \pm 0.013$

Taking the spin of 4 for 1554 Kev level as determined from 264–68 Kev cascade and assuming the spin 3 and 2 for 1331 and 100

Kev levels respectively, the theoretical coefficients for 4(D)3(Q)2 sequence come out to be:

$A_2 = -0.018$
$A_4 = 0$

These results are in good agreement with the measured values.

If we assume the mixed character $E_2 + M_t$ $(29 \pm 8\%)$ for 1231 Kev gamma-ray, as recently reported by Korkman and Backlin[5] from their internal conversion measurements, then the theoretical values of A_2 and A_4 for 4(D)3(D, Q) 2 sequence are:

$A_2 = -0.095$
$A_4 = 0$

This value of A_2 is much higher than the experimental value of A_2. Consequently 29% dipole admixture of 1231 Kev gamma-ray is not favoured by present angular correlation measurements. It can be concluded from the present angular correlation measurements that 1231 Kev gamma-ray is pure quadrupole in character, which is in agreement with the assignment made by Murray et al.[3] on the basis of internal conversion coefficient measurements. These results clearly support a spin assignment of 3 units to 1331 Kev level.

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A NEW FOSSIL INSECT FROM THE LOWER GONDWANAS OF KASHMIR*

K. K. VERMA

Palaeontological Division, Geological Survey of India Southern Region, Hyderabad-28

A NEW fossil insect, *Kashmiroblatta maraho-mensis* Gen. et sp. nov., has been collected by the author from the Gangamopteris Beds exposed at a small spur, locally known as Baliarpatti, near Marahom (Marhama) (33° 50′ : 75° 05′), Anantnag District, Kashmir. The fossil is preserved in the form of an impression of the fore-wing on a slab of grey tuffaceous shale and has been found to be associated with a large number of fossil fishes, *e.g.*, *Amblypteris kashmirensis* Woodward, *Amblypteris symmetricus* Woodward, and fossil plants,

ANTERIOR OR COSTAL MARGIN

INNER OR ANAL MARGIN

FIGS. 1-3. *Kashmiroblatta marahomensis* Gen. *et* sp. nov. Fore-wing (Holotype) G.S.I. Type No. 18274. Fig. 1, × 3. Fig. 2. Diagram illustrating the detailed morphological features of Holotype-18274, × 2. Fig 3. Counterpart of the Holotype-18274, showing venation, × 3.

e.g., *Gangamopteris kashmirensis* Seward, *Glossopteris* sp., *Sphenopteris polymorpha* Feist., *Psygmophyllum* sp., and a labyrinthodont, *Chelydosaurus marahomensis* Verma.

Fossil insects have been reported by Handlirsch (1906–08) and Bana (1954) from the Gangamopteris Beds of Risin spur near Srinagar, Kashmir, and have been described under *Gondwanablatta reticulata* Handl., and *Prognoblattina columbiana* Schudder, respectively. The present record is first from the Marahom area.

Generic diagnosis.—Fore-wing elliptical, thrice as long as broad ; costal area narrow and band-like ; sub-costa reaching upto the tip of the wing with about 12 simple pectinate branches ; radius and media strongly developed and each dividing into two branches ; cubitis with 6 alternately simple and compound branches covering from the lower end of the apical margin to the almost entire free margin ; posterior cubitis, or *vena dividens,* strongly convex and lying in a deep groove ; anal area one-third the wing length with a large number of anal veins, all reaching the inner margin.

Brief Description of the Genotype (G.S.I. Type No. 18274).—Fore-wing about 42 mm. long with strongly curved anterior margin and a straight anal margin. Radius strongly developed, convex and bifurcating into Radius 1 and Radial Sector, the former less dominant than the latter. Media likewise dividing into convex Anterior Media and concave Posterior

Media, which are further branched in and two respectively, all the branche: the apical margin. Cubitis strongly c[u] smoothly curved downwards with six l which are alternately simple and for[k c] area with eight simple as well as c[c] branches, all sloping regularly to th margin. The intercalary venation co[r] a close network of narrow, thin and r veins. The genotype possesses cli characters and the author cannot rec form with which it can be compar[ec] generic name is after the geologicall.y area, Kashmir, and the specific nam[c] the locality of its occurrence, Mara[o]

The author is thankful to Shri M. S sundaram, Director, Southern Region C cal Survey of India, for his keen in[t] this work.

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MUTATIONAL RECTIFICATION OF SPECIFIC DEFECTS IN SOME POTATO VARIETIES

PREM P. JAUHAR AND M. S. SWAMINATHAN

Division of Genetics
Indian Agricultural Research Institute, New Delhi-12

THOUGH the early attempts to induce mutations in potatoes did not yield fruitful results,[2] recent investigations have shown that striking variations can be induced by treating the tuber eyes or young sproutlings with ionizing radiations or radioisotopes.[1,3–8,12] It has also been demonstrated that specific defects can be rectified in polyploid plants through induced mutagenesis, since such plants permit chromosome aberrations to pass through the somatic and gametic sieves[11] more readily than diploids. Hence, a study on the induction of mutations was undertaken in Kufri Red and Kufri

Sindhuri, two commercially important varieties of potato.

Kufri Red, a clonal selection from Dar[j] Red Round, is capable of giving good but has red tubers with deep to mediu[m] eyes.[9] Kishore *et al.*[9] pointed out that it be desirable to get in Kufri Red mutan[t s] white tubers having fleet to medium-dee[p] Similarly, Kufri Sindhuri, an excellent variety suitable for cultivation both i[n] plains and the hilly areas of India, has [a] with red skin and deep to medium-deep e Virus-free stocks of Kufri Red and

Sindhuri kindly supplied by the Director of the Central Potato Research Institute, Simla, were subjected to different mutagen treatments.

The mutagens used were (1) gamma-rays, 6 Kr. and 10 Kr. from a 200-Curie Co⁶⁰ Source, (2) Ultra-violet radiation using a germicidal lamp at 2650 Å for one hour *plus* gamma-rays, 6 Kr. and 10 Kr., (3) radioisotopes—P^{32}, S^{35} and Ca^{45} @ 150μc./tuber or sproutling.

Methods of Treatment.—(*a*) *Gamma-rays*: Each tuber to be irradiated was cut into three pieces from the crown end, out of which one was kept as control and the other two were given 6 Kr. and 10 Kr. doses respectively. The tuber pieces to be irradiated were arranged in concentric circles around the Co⁶⁰ Source in the Gamma Garden.

were separated from each tuber by cutting a small portion off the tuber with the sproutling, care being taken to keep the root system intact. These young sproutlings were then placed for 72 hours in specimen tubes each containing 5 ml. of solution of radioactive isotope (150 μc.). Control seedlings from the same tuber were given the same amount of distilled water. The control and treated seedlings were later planted either in pots or in the field.

Results.—A variety of somatic aberrants was observed in SM₁* and subsequent generations. These included changes in the shape and texture of leaves, and the shape, colour and texture of tubers. The mutations isolated for tuber characters in Kufri Red and Kufri Sindhuri are listed in Table I.

TABLE I

Frequency of occurrence of somatic mutations in Kufri Red and Kufri Sindhuri

Variety	No. of tubers or sproutlings treated	Mutagen used ( )		Altered character	Number of mutants
Kufri red	100	γ-rays		White skin	1
do.	120	UV + γ rays		White skin with medium-deep eyes	2
do.	60	P^{32}		Diffuse pigmentation of tuber	2
do.	60	S^{35}		do.	1
Kufri Sindhuri	150	γ rays	(*a*)	White skin	2
			(*b*)	White skin with fleet eyes	1
			(*c*)	Mericlinal chimera for skin pigmentation	1
do.	120	UV + γ rays	(*a*)	Half of the tubers with white skin and the rest with normal skin	1
			(*b*)	One tuber white and the rest with normal skin	1
			(*c*)	Mericlinal chimera for skin colour	1
do.	60	J^{32}		Diffuse skin colour	2
do.	60	S^{35}		do.	1
do.	60	Ca^{45}		do.	1

* The different clonal generations of treated tubers are referred to as SM₁, SM₂, etc.

(*b*) *Radioisotopes.*—(*i*) *Tuber treatment*: Holes sufficient to hold 5 ml. of the radioisotope solution were made in tubers of uniform size which were then placed in soil with their holes facing up. Five ml. of aqueous solution of the radioisotope were poured into each tuber and the same amount of distilled water into the corresponding controls. The holes were then sealed with cellophane paper and the tubers covered with moist soil. The field was irrigated prior to planting and further irrigations were given only after a month. (*ii*) *Sproutling treatment*: The method of Swaminathan[12] was used. Healthy tubers were allowed to sprout in wooden boxes filled with sand. Five to seven sproutlings emerged from each tuber. When about two weeks old, the sproutlings

The tubers of Kufri Red and Kufri Sindhuri with white skin and fleet eyes bred true for these traits. They are being multiplied for the assessment of their yield potential in comparison with the parent strains. Several genetic factors are involved in the control of pigment formation and eye characters in potato.[13,6] Further studies would hence be needed to ascertain the nature of the genetic change responsible for the somatic mutations isolated during the present study.

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PRELIMINARY STUDIES ON THE EFFECT OF CHOLINE CHLORIDE ON BLOOD COAGULATION

G. N. SRIVASTAVA AND S. S. MUKERJEE

Central Drug Research Institute, Chattar Manzil Palace, Lucknow

CHOLINE chloride has been extensively used as a constituent in high fat atherogenic and thrombogenic diets.[1-4] Howard and Gresham[5] also observed that the ability of a fat to produce thrombosis was enhanced by the addition of choline chloride. However, coagulation studies, carried out in rats maintained on such regimens, revealed that the prothrombin time was shortened on one hand and the thromboplastin generation time prolonged[5] on the other, and the blood rendered less coagulable than normal.[6] No satisfactory explanation for these opposing effects was given. Since choline chloride was common in all these studies and its effect on blood coagulation was not fully known, a preliminary study in this direction was undertaken.

The experiment was conducted on 36 normal, male albino rats of C.D.R.I. colony of average weight 120 g. Blood of 6 rats was utilised for *in vitro* study and the remaining animals were divided into 5 groups of 6 each and used for *in vivo* study. Group I was used as normal control. Each animal of Groups II, III, IV and V was forced fed a single dose of 100 mg. choline chloride dissolved in 2 ml. of distilled water and coagulation studies in each group performed at $\frac{1}{2}$, 1, 2 and 4 hours respectively. The animals were put under light ether anæsthesia and blood withdrawn directly from abdominal aorta in a glass syringe, kept in oxalated bottles and plasma separated.

To test the coagulation mechanism, calcium clotting time, prothrombin time and fibrinolytic activity of plasma were performed in all the groups. Calcium time was done as described by Dacie[7] and prothrombin time by Quicks' one stage technique,[7] using 0.01% solution of Russel's Viper venom in place of brain extract. Calcium time and prothrombin time techniques were modified as described earlier (Srivastava, *et al.*[8]) in case of *in vitro* tests in which 10%, 25%, 50% and 100% solution of choline chloride were added to the clotting mixtures. Fibrinolytic activity of plasma was done as reported earlier.[8]

Table I shows the mean values of *in vitro* tests.

It is seen that both calcium time and prothrombin time became markedly prolonged when a 10% solution of choline chloride was added to the clotting mixture. With 25% solution, the clotting times registered further prolongation until in 50% and 100% solutions the clotting was either totally inhibited or greatly retarded upto a period of 2 hours. These observations showed that choline chloride interfered with the normal coagulability of blood *in vitro*.

TABLE I

Group			Calcium time (Sec.)	Prothrombin time (Sec.)	Fibrinolytic activity (%)
1. Control	..		44·5 ± 1·5 (6)	13·5 ± 0·8 (5)	50·8±2·4 (3)
2. 10% choline chloride	..		126·5*±10·0 (6)	46·4*± 4·1 (5)	48·5±2·2 (3)
3. 25% ,,	..		498·5*±51·3 (6)	137·0*± 11·3 (5)	49·2±0·7 (3)
4. 50% ,,	..		No clotting (4)	1110·0*±210·0 (5) (clotting in only 2 samples)	52·3± ·1 (3)
5. 100% ,,	..		,,	No clotting (5)	50·0±2·5 (3)

* Highly significant (P < ·01). Figures in parenthesis indicate the number of observations.

TABLE II

Group			Calcium time (Sec.)	Prothrombin time (Sec.)	Fibrinolytic activity (%)
I Zero hour	..		39·7 ±1·8 (5)	12·1 ±0·5 (6)	48·8±1·2 (6)
II Half hour	..		46·2*±3·7 (5)	15·0*±0·8 (6)	46·8±1·3 (4)
III One hour	..		53·6*±3·1 (5)	15·5*±0·5 (6)	48·3±3·1 (6)
IV Two hours	..		45·9*±2·4 (4)	15·3*±1·0 (6)	51·8±2·6 (6)
V Four hours	..		39·7 ±3·0 (5)	11·4 ±0·5 (6)	44·8±1·6 (6)

* Highly significant (P < ·01). Figures in parenthesis indicate the number of observations.

The mean values of coagulation tests at ½, 1, 2 and 4 hours after *in vivo* administration of choline chloride are summarised in Table II.

The study of the table shows that the calcium time and prothrombin time increased from ½ hour interval lasting upto 2 hours and tending to return towards original values at 4 hours interval.

Fibrinolytic activity of plasma in both experiments did not show an appreciable change.

Both these studies indicated that choline chloride had an anticoagulant effect. This effect was more pronounced *in vitro* than *in vivo*. This was perhaps due to the oral route of administration where only a comparatively lower concentration of choline chloride was attained in the plasma. Higher or repeated oral doses might cause a similar effect as *in vitro*.

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LETTERS TO THE EDITOR

ON THE MEASUREMENT OF ABSOLUTE YIELD OF FLUORESCENT X-RAYS EMITTED FROM A TARGET IRRADIATED WITH GAMMA-RAYS

In two recent communications[1,2] we reported the measurements of photo-electric cross-sections and Compton scattering cross-sections from bound electrons. The measurements involved the determination of the absolute yield of fluorescent K-radiation that are emitted when the target is irradiated with known flux of gamma-rays.

The value of the absolute yield of fluorescent K-radiation was calculated from the intensity measured under the photo-peak in the spectrum of the radiation obtained by $1'' \times 1''$ NaI(Tl) spectrometer by correcting for : (i) absorption of the K-radiation in the air between target (source of K-radiation) and detector; (ii) absorption in the front face of the crystal package through which radiation has to pass before reaching the crystal; (iii) the escape of iodine X-rays in the crystal. These corrections were estimated from the data available in literature.[3-5] We have now measured the value of the effective photo-peak efficiency of the detector for the fluorescent X-radiation under our experimental arrangement and report the results in this letter.

The target in our experimental arrangements was replaced by radioactive sources of Hg-203, Au-198, Ce-141 and Cs-137 which have known K-shell internal conversion coefficients.[6,7] The photo-peak areas in the spectrum of gamma-rays and K-shell X-rays emitted from the source following internal conversion were measured with the detector. From the known values of the internal conversion coefficients, fluorescent yield and photo-peak efficiency of the detector

for gamma-rays[5,9] the photo-peak efficiency of fluorescent radiation was calculated from the relation

$$\alpha_K = \frac{\epsilon_\gamma \; I_K \; A_\gamma}{\omega_K \; \epsilon_K \; I_\gamma \; A_K} \; \beta$$

where α_K is the K-shell internal conversion coefficient, I_K and I_γ are the measured intensities of K-radiation and γ-rays, respectively. A the attenuation factor due to absorption between yield of the daughter nucleus, ϵ the photo-source and the crystal, ω_K the K-shell fluorescent peak efficiency of the detector and β the correction due to iodine escape peak.

The results are tabulated in Table I for $1'' \times 1''$ Harshaw 4D4 crystal when the distance between source and detector is 18 cm.

TABLE I

Photo-peak efficiencies of K-radiation

Source	Energy in keV		$\epsilon_\gamma \; A_\gamma$	ω_K	$\epsilon_K \; A_K \; \beta$	
	γ-ray	X-ray			Calculated	Experimental
Hg-203	279	72·9	0·377	0·955	0·88	0·86 ± 0·04
Au-198	411	70·8	0·231	0·954	0·87	0·89 ± 0·04
Ce-141	145	36·0	0·737	0·900	0·64	0·63 ± 0·03
Cs-137	662	32·2	0·115	0·883	0·76	0·73 ± 0·04

An agreement between the experimental and calculated values confirms the validity of the corrections applied in our earlier measurements.

Physics Department,   B. S. Ghumman.
Punjabi University,   S. Anand.
Patiala, *April 12, 1967.*   B. S. Sood.

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EXP : EXP POTENTIAL FUNCTIONS FOR SOME SPHERICAL NON-POLAR ' MOLECULES

RECENTLY an exp : exp potential energy function was introduced to compute the second virial coefficient and viscosity of gases in a search for a satisfactory potential to study the interaction between molecules.[1] The results making use of the potential parameters evaluated from the second virial coefficient and crystal property data[2] were not very promising. These calculations, however, do not permit a very specific conclusion concerning the adequacy of this potential. There are quite a few convincing arguments[3] suggesting that the use of potential parameters from crystal data is not very proper. Further a single set of parameters is not suitable for discussing both the equilibrium and the transport properties.[4] This clearly indicated the desirability of a further investigation to assess the relative suitability of this potential as compared to other potentials, for example the widely used Lennard-Jones 12 : 6 or the exp : six potential.

We have used the temperature dependence of thermal diffusion, which is preferable to other

where ϵ is the depth of the potential at its minimum, where $r = r_m$, σ is the finite value of r for which $\phi(r) = 0$. The parameter c determines the curvature of the potential at its minimum as well as the steepness of the repulsive potential. The experimental thermal diffusion data for argon[8] and methane[9] were reduced and the potential parameters c and ϵ determined by a method given earlier[5] using the evaluated collision integrals[10] and the expression for thermal separation ratio R_T to its first approximation.[5,6] The values given in Table I correspond to the temperature range 150° K. to 450° K. for argon and 250° K. to 500° K. for methane. There is an indication towards lower values of c at lower temperatures which however may extend upto 300° K. The theoretical and the experimental plots of R_T suggest that the potential is adequate only for moderate temperatures. For very low temperatures another set of parameters are required, while for high temperatures the potential seems to be unsuitable. To calculate σ, the thermal conductivity data for argon[11] and viscosity data for methane[4] were used. We see from Table I that the parameters determined from the equilibrium and

TABLE I

Values of the Exp : Exp potential parameters for argon and methane

	Argon				Methane			Property used
c	$\epsilon/k(°K)$	$\sigma(\text{Å})$	$r_m(\text{Å})$	c	$\epsilon/k(°K)$	$\sigma(\text{Å})$	$r_m(\text{Å})$	
5·0	115·4	3·477	3·961	5·0	121·0	3·884	4·425	Thermal Diffusion (Present Work)
5·0	144·8	3·386	3·855	4·9	177·5	3·683	4·204	Second virial coefficient and crystal data (a),
5·7	120	3·461	3·882	—	—	––	—	Viscosity (b)
5·064	132·64	3·554	4·041	5·561	221·03	3·5097	3·949	Second virial coefficient and viscosity (c)

(a) Konowalow, D. D. and Hirschfelder, J. O., *Phys. Fluids*, 1961, **4**, 629.
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properties due to its comparative sensitiveness to the type of molecular interaction, for the determination of the potential parameters. The method used was that given by Srivastava and Madan[5] and subsequently applied by Madan and others.[6] Argon and methane were chosen for investigation on considerations of the availability of the reasonable data.[7] The ability of these parameters to reproduce the experimental data has been tested on the coefficients of viscosity and self-diffusion.

The exp : exp potential energy between two molecules separated by a distance r is given by

$$\phi(r) = \epsilon \left\{ \exp\left[-2\left(\frac{c}{\sigma}\right)(r - r_m) \right] - 2\exp\left[-\left(\frac{c}{\sigma}\right)(r - r_m) \right] \right\}$$

the transport properties have marked differences, which have also been observed for other potentials as well. This may be the reason why the crystal and virial property parameters are unable to reproduce the transport properties satisfactorily.

When we compare our viscosity values (Table 2) with those computed earlier[1] as well as with the values using an exp : six potential[12] we find that our values are markedly better than the values obtained using the parameters from the virial and crystal property data and as well as other transport property data, leading us to believe that the overall agreement for this potential is superior to that afforded by other potentials and even for this potential comparatively our parameters are more accurate.

The values for self-diffusion, though not decisive as regards the potential, are equally good and satisfactory.

TABLE II

Experimental and calculated values of the co-efficients of viscosity η and self-diffusion D for argon and methane

Temp	$\eta \times 10^7$ gm. cm.$^{-1}$ sec.$^{-1}$ Argon	
(°K)	Experimental[a]	Calculated
80	688	653
100	839	816
140	1146	1139
160	1298	1298
200	1594	1001
240	1878	1878
280	2145	2145
300	2270	2270

Temp.	D cm.^{2} sec.$^{-1}$ Argon	
(°K)	Experimental[b]	Calculated
77·7	$0 \cdot 0134 \doteq 0 \cdot 0002$	0·0137
90·2	$0 \cdot 0180 \pm 0 \cdot 0003$	0·0184
194·7	$0 \cdot 0830 \pm 0 \cdot 0011$	0·0839
273·2	$0 \cdot 156 \doteq 0 \cdot 002$	0·157
353·2	$0 \cdot 249 \pm 0 \cdot 003$	0·253

Temp.	D cm.^{2} sec.$^{-1}$ Methane	
(°K)	Experimental[b]	Calculated
90·2	$0 \cdot 0266 \doteq 0 \cdot 0023$	0·0228
194·7	$0 \cdot 0092 \pm 0 \cdot 0006$	0·104
273·2	$0 \cdot 206 \pm 0 \cdot 005$	0·196
298·2	$0 \cdot 240 \pm 0 \cdot 004$	0·231
353·2	$0 \cdot 318 \pm 0 \cdot 005$	0·315

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It is a pleasure to thank Prof. P. N. Sharma for his interest.

Dept. of Physics,   SHAILENDRA KUMAR.
University of Lucknow,   M. P. MADAN.
India, *March* 20, 1967.

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SYNTHESIS OF 7-HYDROXY-11:12-DIMETHOXY COUMESTAN—A COMPONENT FROM ALFALFA

SPENCER, Knuckles and Bickoff[1] isolated 7-hydroxy-11:12-dimethoxy coumestan from alfalfa. Its structure was established on the basis of spectral data and by conversion to the known 7:11:12-trimethoxy coumestan. They also synthesised the compound following the procedure of Jurd[2] by H_2O_2 oxidation of 6:7:2′:4′-tetrahydroxy flavylium chloride and selective methylation of the resulting 7:11:12-trihydroxy coumestan.

The synthesis of 7-hydroxy-11:12-dimethoxy coumestan has now been achieved following the recent method of Wanzlick[3] which involves the oxidative coupling of 4-hydroxy coumarin with catechol in the presence of potassium ferricyanide under weakly basic conditions. 7-Benzyloxy-4-hydroxy coumarin (II), was prepared by the condensation of 4-benzyloxy-2-hydroxy acetophenone (I), with ethyl carbonate adopting Boyd and Robertson method.[4] Dehydrogenative condensation of (II) with catechol in the presence of potassium ferricyanide and sodium acetate furnished 7-benzyloxy-11:12-dihydroxy coumestan (III), which on methylation afforded the corresponding dimethyl ether (IV). Finally, debenzylation of (IV) with a mixture of glacial acetic acid and hydrochloric acid (1:1) gave 7-hydroxy-11:12-dimethoxy coumestan (V) m.p. 293° C., and acetyl derivative, m.p. 213° C. The spectral data of the synthetic coumestan (V) are as follows:

U.V. absorption, $\lambda_{max.}^{EtOH}$ 246 mμ (log ϵ 3·94), 280 (3·55), 295 (3·55), 305 (3·67), 350 (4·09).

No. 13
July 5, 1967]

Letters to the Editor

347

I.R. absorption, 3333 cm.$^{-1}$ (— OH group), 1695 cm.$^{-1}$ ($>C=O$), 1631 cm.$^{-1}$ ($>C=C<$).

The synthetic 7-hydroxy-11 : 12-dimethoxy coumestan and its acetyl derivative were found to be identical with the natural specimen and its acetate in m.p. as well as in spectral data. Synthesis of coumestans by potassium ferri-cyanide oxidation is very facile and the yields are high.

We convey our thanks to Prof. E. M. Bickoff, Principal Chemist, Forage Investigations, Field Crops Laboratory, Albany, California, for providing us the natural 7-hydroxy-11 : 12-dimethoxy coumestan and its acetyl derivative.

Chemistry Dept.,   D. Malleshwar.
Osmania University,   G. Srimannarayana.
Hyderabad-7 (A.P.),   V. Sundaramurthy.
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STUDIES ON ANTI-AMOEBIN, AN ANTIPROTOZOAL ANTIBIOTIC

Anti-amoebin is a new antibiotic, synthesized by Hindustan Antibiotics Ltd., Pimpri. It is a white crystalline solid with a melting point between 219°–220° C. The drug is insoluble in water, weak alkalies, weak acids, acetone, chloroform or fixed oils and is soluble in absolute alcohol and propylene glycol. It is usually agreed that substances affecting motility of earthworms are likely to possess anthelmentic actions against round-worms.[1] Therefore, the action of the drug on the earthworms was studied using a solution of the drug in propylene glycol or in alcohol. In some experiments an aqueous suspension using pulv. tragacanth as suspending agent was also employed. The solution invariably reduced the motility of earthworms (*Pheretima posthuma*), but as the solvent alone had similar effects, this could not be attributed to the presence of the drug, particularly in view of the fact that the aqueous suspension of the drug did not produce any effect on the worms.

The action of anti-amoebin was also tested on a motile protozoal parasite of the frog colon (Opalina). In the concentration of 0.5×10^{-4}, the drug consistently reduced the number of actively motile parasites to one-third of the control value. Thus the drug was demonstrated to produce an antiprotozoal effect.

The pharmacological actions of the drug were tested on dog blood pressure, isolated rabbit heart, smooth muscles of the rabbit ileum and on neuromuscular transmission in the frog. In doses ranging from 5 to 500 μg. per kg. body weight, it did not produce any action on the blood pressure, spleen volume and contractions of the nictitating membrane of the anaesthetised dog. The responses of these preparations to adrenaline, noradrenaline, acetylcholine, histamine and serotonin remained unchanged after the administration of the drug. It did not alter coronary flow or heart rate in the isolated preparation of the rabbit heart (Langendorff). In concentrations of 10^{-5}, it did not affect the spontaneous contractions of rabbit ileum, or the contractions of frog rectus induced by acetylcholine. Anti-amoebin does not seem to be an irritant as it did not produce any irritation on rabbit conjuctiva in concentration of 10^{-3}.

FROG GASTR CNEMIUS SCIATIC

Fig. 1. The effect of anti-O amœbin (A.A 10^{-3}) on the contractions of gastrocnemius muscle of frog stimulated through sciatic nerve with pulse of 4 volts per second. The time in minutes at each subsequent arrow.

In the next set of experiments the effect of anti-amoebin was studied on gastrocnemius-sciatic preparation of the frog. The nerve was stimulated at a constant rate of one stimulus of 4 volts per second using an Inco stimulator. In presence of the drug in a concentration of

10^{-3}, there was a progressive diminution in the response of the muscle to the electrical stimuli (Fig. 1). As it has been shown that the skeletal muscle contraction induced by acetylcholine is not influenced by the drug, it would appear that the site of action of anti-amœbin is likely to be at the neuromuscular junction. Thus it is possible that the drug may produce a sensation of weakness, otherwise it is pharmacologically inert and as such not likely to produce side effects.

The studies were carried out during the tenure of a junior I.C.M.R. fellowship to one of us (M.D.). The samples of antiamœbin were received from Hindustan Antibiotics, Ltd., Pimpri, through the kind courtesy of Director-General of Indian Council of Medical Research, New Delhi.

Department of Pharmacology,   MEENA DAVE.
Maulana Azad Medical   A. R. LADDU.
     College,   R. K. SANYAL.
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A MODIFICATION OF KING AND ARMSTRONG'S METHOD OF ESTIMATION OF SERUM PHOSPHATASES

ESTIMATIONS of serum alkaline and acid phosphatases are of great diagnostic importance in clinical enzymology and, as such, are very common tests done in hospital laboratories. Both the enzymes can hydrolyse, at its own pH optimum, ester phosphates with the liberation of an alcohol and inorganic phosphate. Because of the difference in their pH optima, the one which is most active in the pH range 8-10 has been designated as alkaline phosphatase, while the other with its maximum activity at pH 5 is known acid phosphatase.

King and Armstrong[1] introduced a method for the estimation of these phosphatases in serum and tissue extracts. Phenylphosphate, which is employed as the substrate in this method, is hydrolysed by the enzyme and the amount of phenol liberated under standard conditions measures the amount of the enzyme present. Later, several substituted phenylphosphates[2,3] have been employed in order to simplify the method. As these chemicals, *e.g.*, p-nitrophenylphosphate, phenolphthalein phosphate, etc., are not easily available, the phenylphosphate method of King and Armstrong still continues to be the most commonly employed method in this country.

FIG. 1. Absorption spectra of the coloured solutions obtained with phenol and tyrosine standards.

One handicap of this method for routine work is that a standard solution of phenol cannot be prepared by directly weighing the required amount of phenol and dissolving it. Owing to the deliquescent nature of phenol and its susceptibility to oxidation on exposure to air and light, the strength of the solution has to be checked by iodine titration. To circumvent this difficulty, the possibility of using a standard solution of tyrosine instead of a standard solution of phenol was investigated in this laboratory. The reason for the selection of tyrosine for trial as a possible substitute of phenol in this test was based on the consideration that this compound has in its molecule a phenolic radical and like phenol it is known to produce a blue colour by reacting with Folin-Ciocalteu reagent.[4]

A stock solution of tyrosine, equivalent to 1 mg of phenol/ml. calculated on the basis of the presence of one phenol radical per molecule of tyrosine, was prepared by dissolving 192·6 mg.

$$\left(\frac{\text{mol. wt. of tyrosine}}{\text{mol. wt. of phenol}} \times 100 \right)$$

in 0·1 N HCl and making up the volume to 100 ml. A stock solution of phenol, 1 mg./ml. in 0·1 N HCl, was also prepared and its exact strength was determined by titration. Working standard solution of each, 0·01 mg./ml. as phenol, was then prepared by the appropriate dilution of the stock.[5] Optical density readings at different wavelengths of the colours produced by the reaction of the two solutions with Folin-Ciocalteu reagent were found to be almost identical. This showed that in King-Armstrong's

method of estimation of the phosphatases, phenol standard may be very advantageously substituted by a tyrosine standard of equivalent concentration.

Department of Biochemistry,　　　P. DATTA.
Maulana Azad Medical College,
New Delhi-2, *February* 3, 1967.

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OCCURRENCE OF CHLORITOID IN SHEENY PHYLLONITE FROM CHAIL AREA, SIMLA HILLS (INDIA)

THE authors record the occurrence of chloritoid in 'Sheeny Phyllonite' for the first time from the Chail area (30° 57′ 30″–33° 55′ 0″ N. Lat. and 77° 10′–77° 15′ E. Long.), Simla Hills (India).

The phyllonite occurs as Tectonic Augens, which apparently rests over the Chail Series (Pilgrim and West, 1928) and slaty formations of the area. The sheeny phyllonite occurring as tectonic caps, measuring from 50–200 metres in width and 100–500 metres in length, outcrops near Siaula, Blossom and Tikkar. Their longer axis lies in a NE-SW direction. The general strike trend of foliation of phyllonite runs parallel to the regional strike trend, WNW-ESE, but it frequently changes towards NNW-SSE.

The green, greyish-green colour, sheeny lustre and soapy touch distinguishes the rock from other formations in the area. At times green mineral (chlorite) streaks, parallel to the main lineation in the rock, are well developed. Under the microscope the rock is characterized by interbanding of leucocratic quartz-rich and mesocratic chlorite-chloritoid-rich bands. Idioblastic to subidioblastic laths of chloritoid (Fig. 1) show preferred arrangement with their longer axes parallel to the main foliation. The constituent minerals of the rock are quartz, sericite, chlorite, chloritoid, ferrimuscovite, magnetite, with clinozosite, tourmaline, hæmatite and ilmenite.

Pale bluish-green, tabular, prismatic laths of chloritoid measuring up to 2 mm. show a faint pleochroism and dusty inclusions. The mineral is characterized by high R.I. as compared with chlorites. Optically the mineral is length fast (positive) with $2V = 47°$, and shows nearly parallel extinction.

Its well-developed cleavage, hour-glass structure between crossed nicols, and high refractive index, easily distinguishes the mineral from chlorite and other related minerals.

FIG. 1

The authors believe that the chloritoid is a product of dislocation movement (Read, 1937; Atkinson, 1956). Such tectonic movements were active during the Himalayan Orogeny resulting in thrusting of sheeny phyllonite over the Chail and slaty formations of the area. They also support the view that chloritoid is a stress mineral and was formed in a chemically Al and Fe-rich environment, and deficient in magnesian lime and potash (Harker, 1932).

Dept. of Geology,　　　I. C. PANDE.
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NOTE ON THE ENERGETICS OF GROWTH IN *OPHIOCEPHALUS PUNCTATUS* BLOCH

IN the life of any organism food supply appears to be the most potent factor affecting growth. Much work has already been done on the food supply, growth, and energy turnover in fish. But most of the literature relate to fishes of colder regions. Ivlev (1939)[1] was the first to

work out the relationship between food consumed and utilized for growth. Others who followed, related growth in the different age groups,[2] or approximated food supply and growth to total metabolism[3] or studied the problem in relation to temperature and salinity,[4] and food input and energy extraction.[5]

The investigations by Mookerjee *et al.*[6] and by Qasim and Bhatt[7] on *Ophiocephalus punctatus,* an important food fish in India, refer to the composition of food and the length/weight relationship of this species. They however do not relate the study to energy turnover in the species. Hence it was felt very necessary to study more thoroughly the food requirements, growth rate and conversion efficiency on this species of fish. The present note deals with a preliminary study made in this direction.

The fish of three size groups (A) 5·5 ; (B) 15·5 ; and (C) 30·4 gm. were collected and reared in glass aquaria separately at an average temperature of 26·5° C. in about 42 litres of tapwater. They were fed with *Lepidocephalichthys thermalis.* The weight of food consumed, the growth of the fish, and the weight of fæcal matter released were recorded every ten days. The fish were given restricted food supply for one hour in the morning, and one hour in the evening.

The figure illustrates the observations of food consumed/unit weight, growth and percentage gain in weight by the three size groups, A, B, and C respectively. It is seen that the smallest

FIG. 1

group far surpasses the other two groups in food consumed/unit weight of the body, percentage gain in weight and absolute growth over a period of ninety days. However the average efficiency of absorption of food was nearly identical for all sizes amounting to 84·5%

average. Therefore, it is obvious that the intake of energy being the same the inverse relationship in actual gain in weight indicates that the cost of maintenance energy is higher proportionately in the larger fish. It is also reflected in an inverse relationship in the conversion of food into flesh, *viz.* (conversion efficiency) which amounted to 30% in the smallest group, 21% in the intermediate group and 13% in the largest group. One common feature seen in all the fish is that the rate of food consumed/unit weight, was progressively falling in all the size groups over this period of observation. This is known to be the case in other similar studies also, the main factors causing it being temperature and light. In the present study the lowest temperature of 24° C. was recorded in the latter part of the observation under reference.

I am grateful to Dr. S. V. Job, under whose guidance this work was carried out. I am thankful to Prof. S. Krishnaswamy for his valuable sugestions.

Department of Zoology,   V. VICTY MERCY.
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NUCLEAR SEX IN THE NEUTROPHILS OF TWO SPECIES OF CHIROPTERA

SEX differences in the leucocytes of peripheral blood were first demonstrated by Davidson and Smith[1] in man and was later confirmed by a number of other workers.[2,3] The technique is so simple and useful that the study gained importance in diagnostic and clinical work. Sexual dimorphism has also been observed in the neutrophils of peripheral blood of various mammalian species.[2] In all the species studied, it is the genetic female which shows a characteristic accessory lobe or "drum-stick", while the genetic male does not show it. Autoradiographic studies reveal the functional analogies of the drum-stick, sex chromatin and the sex chromosome. The "drum-stick" is derived from heteropycnotic, asynchronous X-chromosome in

the female sex,[4] and appears to form during the maturation of the neutrophils.[5]

A review of literature indicates that only one species of Chiroptera (*Pipistrellus pipistrellus*) has been studied from this point of view[2] and no report on Megachiroptera is available. In this note we record our observations on two species of bats, *Pteropus giganteus giganteus* (Brünnich) (sub-order Megachiroptera) and *Taphozoas* sp. (sub-order Microchiroptera). Blood smears were made of both males and females and fixed in a mixture of equal proportion of ether : alcohol for 5 to 10 minutes and stained in both Feulgen and hæmatoxylin.

Several polymorphic neutrophils were noticed in the smears of the females with the typical "drum-sticks", the latter connected to the main body of the nucleus by a fine strand. In 300 neutrophils studied in each species, only the females showed the drum-sticks in about 3·3% of the nuclei (Fig. 1). None were found in the males.

F,G. 1. A typical drum-stick in the neutrophil of *Pteropus giganteus*.

Department of Zoology,   S. R. V. Rao.
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LIGULELESS CONDITION IN RICE

Mutants in rice lacking auricle, ligule and junctura have been studied by Kato cited by Ikeno (1919), Jones (1933), Morinaga and Fukushima (1943), Nagao and Takahashi (1952), Ramiah (1953), Pawar *et al.* (1954),

Ghose *et al.* (1957), Seetharaman (1964) and Hsieh and Yen (1966). In all these investigations the absence of all three parts was inherited as one unit. Piacco (1939) reported a mutant lacking ligule and auricle only but no reference is made about the presence or absence of junctura. In investigations carried out at the Central Rice Research Institute, Cuttack, it was noted that auricle, ligule and junctura were not inherited as one unit in some cases.

In Fig. 1 is shown the leaves of segregants possessing one or more of these parts. A portion of leaf magnified to show the rudimentary auricle is shown in Fig. 2.

In earlier investigations it was believed that the absence or presence of all the three parts was inherited as if a single factor was responsible. Ghose *et al.* (1957) suggested independent loci. The present study shows that the position is as follows :

(*i*) if only one part is present it is always the ligule.

(*ii*) if two parts are present these are the ligule and the junctura.

(*iii*) in the presence of junctura auricles may be present or absent ; if present the auricles may be either fully developed or rudimentary in nature.

(*iv*) development of auricles does not probably take place in the absence of ligule and junctura.

Mutant forms with auricle alone, or with junctura alone, or with junctura and auricles only or with ligule and auricles only have not been obtained so far.

Dominance of alleles controlling the presence of these parts has been reported by several workers. However, in two independent studies carried out by the author, it was found that in one case the F_1 plants had only ligule (auricle and a clear junctura absent) while in the second instance the F_1 plants lacked completely the three parts. In both the cases one of the parents was a liguleless type lacking all three parts and the other was a normal type. Complete absence of auricle, ligule and junctura in the F_1 generation was earlier recorded by Pawar *et al.* (1954).

Roy (1963) from anatomical studies concluded that the formation of ligule primordium is independent of the presence of junctura. Auricles, according to him, are derived partly from the ligule and partly from the sheath. Independent origin of ligule is established. The present study however, shows that in the presence of ligule, junctura may

or may not get differentiated and to this extent (in the limited sense) junctura development is independent. Further, in the presence pendent. But the presence of auricles presupposes the presence of ligule and junctura and the presence of junctura presupposes the

FIGS. 1–2

Fig. 1.   Leaves showing the presence or absence of parts.

Left to right	1	2	3	4	5
Ligule	−	+	+	+	+
Auricle	−	−	+ R	−	+
Junctura	−	+	+	−	+

+ Present.   − Absent.   R Rudimentary.

Fig. 2.   Leaf (magnified) to show rudimentary auricle (3rd in Fig. 1).

of ligule and junctura auricles may be either fully developed or rudimentary or absent. In this limited sense auricle development is independent. presence of ligule.   The interrelationship of genes controlling auricle, ligule and junctura is being studied.

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A NEW *ANTHOCEROS* FROM KERALA

BACK in 1950 s, I received a few black-spored specimens of *Anthoceros* with a collection of *Pallavicinia* from Kottayam, Kerala. Notwithstanding my continuous efforts, I have not been able to have a further collection of the same and a fuller study of the taxon could not be undertaken. However, the material available suggests a distinct characterisation and I am describing it under the provisional name of *Anthoceros shivnandani* (in herb).

Plants dioecious : the thalli firmly attached to soil, dark green, 1–2 times dichotomously branched with an entire margin and cavernose. Dorsal surface flat ; epidermal cells 5–6-angled : marginal ones 30 × 21 μ or 36 × 18 μ, towards the margin 36 × 27 μ, and those towards the middle 39 × 24 μ or 27 × 30 μ. Large mucilaginous cavities in 3–4 transverse rows inside, marked by a network of dark lines externally. *Nostoc* colonies present or absent ; lacunae in 2 broad rows in the wings (transverse). Midrib 18-24 cells thick.

Male plants about 1·5 cm in diameter and closely associated with female plants. Antheridial papillae less conspicuous, antheridia up to 20 within a chamber, each long stalked, with the wall divided into 4 chambers, opening by 4 prominent teeth and ca 46 μ long.

Female plants larger, ca 3 cm. in diameter, 5-15 capsules per thallus, more towards the margin, usually solitary. Pore with its guard cells 39 × 24 μ, the pore 15 × 9 μ (in a few specimens 51 × 30 μ and 15 × 6 μ, respectively). Spores (Fig. 1) black, spherical, 27 × 30 μ in

diameter with mammillose exine, the mammilae being conical-obtuse and much raised up from the surface. Surface of the individual mammillae irregular. Triradiate mark indistinct. Elaters dark brown to blackish, aspiromitioid, with dense contents, rarely branched, about 150 × 3·1–12 μ, 180 × 9–12 μ, 210 × 6 μ, or 57 × 12 μ.

FIG. 1. Spores of *Anthoceros shivnandani*.

Grows on fertile alluvial soil in moist cuttings and shady areas in garden beds, twice a year during monsoons, at Kottayam. Collector : Shri Shivnandan Nayar, August 22, 1952.

Indian Coun. of Agri. Res.,   P. KACHROO.
New Delhi, *January* 3, 1967.

PREFERENCE OF THE LEAF-HOPPER *EMPOASCA KERRI* PRUTHI (HOMOPTERA: JASSIDAE) TO PIGEON PEA [*CAJANUS CAJAN* (L.) MILLSP.] PLANTS INFECTED WITH STERILITY MOSAIC VIRUS

INCREASED importance has been attached in the recent past to the study of host selection in phytophagous insects, and the basis of such a selection is well established in certain species. However, preference of insects for healthy and diseased plants has not been investigated adequately. Nor is the mechanism of preference in this regard clearly understood. It is however acknowledged that a virus can alter the effectiveness of a plant as a host of insects. In the present study, the infestation of the leaf-hopper, *Empoasca kerri* Pruthi, a non-vector of the virus, on healthy and sterility mosaic diseased plants of pigeon pea [*Cajanus cajan* (L.) Millsp.] was observed under field conditions. It was ascertained that the plants were free from any other diseases at the time of observation.

Nymphal counts were made during early hours of the day on healthy and diseased pigeon pea plants of 4-months in age in the fields with reference to five leaves from the terminal end of the main shoot leaving the first three leaves being too tender. Eighty plants at the rate of 40 each from healthy and diseased plants were selected at random and, in all, 400 leaves were examined for leaf-hopper population in each of the five counts made at an interval of four days.

The results illustrated in Fig. 1 show

FIG. 1

consistent differences in the level of population infesting the healthy and viruliferous plants, and in view of this, five periods of observation were considered to be sufficient to arrive at the conclusions indicated below. The leaf-hoppers exhibited a definite preference for the diseased plants over healthy ones, and the difference in the pest incidence was highly significant to the level of 0·1%. The ratios between the two populations, mosaic/healthy, from all the five periods of observation, gave a mean as high as 4·17 with a standard error of 0·43. Though the insects normally preferred leaves of medium maturity over the very tender and very old ones, the difference in the pest infestation on the healthy and viruliferous plants was always maintained irrespective of the age of leaves.

Many previous workers have reported instances which indicate that virus-affected plants are more favourable hosts for both vector and non-vector insects, even though the basis for such preference has not been established yet. Carter,[1] working with yellow-spot of pine-apple, observed increased populations of *Thrips tabaci* Lind. on diseased than on healthy *Emilia sochifolia* plants. Nine species of leaf-hoppers were reported to develop faster, live longer, and reproduce more on their hosts infected with California aster-yellows virus than on non-viruliferous celery plants.[2] *Aphis fabœ* Scop. and *Myzus persicœ* (Sulzer) multiplied substantially faster on many virus-diseased leaves than on healthy leaves of comparable age.[3-5] Similarly the corn leaf-hopper *Dalbulus maidis* (DeL. and Wolc.) also preferred aster-yellows virus-diseased plants.[6,7]

Curiously, however, Jensen[8] produced the first authentic report that a strain of Western X-disease virus was causing premature death of its leaf-hopper vector, *Colladonus montanus* (Van Duzee). Again, failure of *Myzus pesicœ* to colonize readily on tobacco, *Gomphrena* and *Zinnia* plants infected with cucumber mosaic virus was also reported.[9]

The preference of *Empoasca kerri* may first be explained based on physical characters of plants. The diseased leaves are much thinner and softer which is rather very conducive for the easy penetration of the feeding stylets and ovipositor. It is also possible that the profuse and bushy vegetative growth obtained in the infected plant offer adequate shelter and protection for the insect which avoids higher temperatures.

A more plausible explanation may be given from the view-point of the nutrition physiology of the leaf-hopper. Narayanasamy,[10] Narayana-samy and Ramakrishnan,[11] and Nambiar,[12] studying the virus in this institute, have conclusively shown that diseased pigeon pea plants have a higher content of total nitrogen, free amino-acids and peptides, and lower carbohydrate content than the healthy plants. Nambiar[12] noted 11·3 to 29·8% increase in N content in the diseased leaves tested. The preference of *E. kerri* for higher levels of nitrogen is in conformity with similar reported cases among allied species, e.g., castor leaf-hopper *E. flavescens* (F.),[13] and cotton leaf-hoppers *E. terra-reginœ* (Paoli)[14] and *E. devastans* Dist.[15] The chemotactic influence of amino-acids and amides on *E. kerri* may be similar to that reported in *E. flavescens*[13] and *Acyrthosiphon pisum* (Harr.).[16] The possible reduction in amino-acid content in the CMV affected plants was postulated by Lowe and Strong[9] to be one of the causes of the failure of aphids to colonize on these plants.

Though sugars in low concentrations may act as phagostimulants they are definitely toxic in higher concentrations. The high content of carbohydrate in the healthy pigeon pea plants ranging from 26·4 to 34·0% over diseased ones in leaves of medium maturity[12] is probably not attractive to *E. kerri*. The leaf-hopper prefers a reduced C : N ratio found in the diseased leaves. That a low C : N ratio was characteristically associated with the preference of insects was also shown by Maltais and Auclair[17] in the case of *Acyrthosiphon pisum* (Harr.), Grison[18] in *Leptinotarsa decemlineata* (Say) and Jayaraj[13] in *Empoasca flavescens* (F.).

Detailed studies on the nutrition physiology of the leaf-hopper including enzymatic studies are required for a thorough understanding of the problem, for Orenski[7] has indicated that aster-yellows virus might facilitate the digestion of unfamiliar food by stimulating the production of amylase in the leaf-hopper *Dalbulus maidis* (DeL. and Wolc.).

Faculty of Entomology,   S. JAYARAJ.
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RESIDUAL EFFECT OF CYTOPLASM ON GYNAECIUM IN SORGHUM MALE-STERILE LINE C.K. 60 A

THE success attained with hybrid corn has stimulated interest in the use of this method of breeding with sorghum. Many workers have reported the existence of heterosis in sorghum, but for want of economic device of producing sorghum hybrids, its commercial cultivation was not possible.

The genic male-sterile types in sorghum were reported in 1929, 1936 and 1937. Male sterility due to the interaction of cytoplasm and nuclear factors was demonstrated[2] in a combination of Milo cytoplasm and Kafir nuclear factors, which provided a satisfactory tool for the production of commercial hybrids.

In India two sorghum hybrids, CSH-1 and CSH-2 produced by using C.K. 60 A as female and I.S. 84 and I.S. 3691 respectively as male parents, have been released for commercial cultivation. It was observed at different locations in Maharashtra that seed setting in some of the plants of C.K. 60 A in certified and foundation seed-plots was low though the two parents nicked well (Fig. 1). In plants in

FIG. 1. A. Male sterile earhead with full seed set. B. Male sterile earhead with partial seed set indicating complete sterility in patches at different locations.

which seed set on earheads was not uniform, it was observed that there were scattered patches of completely sterile spikelets, which indicated that the sterility was not restricted to any particular region of the earhead. Such type of sterility is observed in all the seasons, in different soils and under low or high fertility conditions, thus eliminating environmental effect as a cause for such phenomenon. This sterility leads to reduced yields, as sectors of completely sterile spikelets occur in about 20 to 25% plants.

Such type of sterility occurs only in male-sterile C.K. 60 A line and not in C.K. 60 B, which is its maintainer. These two lines are isogenic and the only difference in them is that of cytoplasm. This indicates that the sterility on different parts of earhead was due to the effect of cytoplasm, as line 'A' has Milo cytoplasm and Kafir nuclear components while line 'B' is entirely Kafir type.

Morphological observations on sessile and pedicelled spikelets of normal male-sterile and sterile spikelets from the same earhead, indicated that there was an effect on the development of spikelets.

Plant part	Completely sterile	Normal male-sterile
1. Spikelet ..	Whitish or pale green under developed	Green fully-developed
2. Outer glumes	Covered with short woolly hairs, thin and soft	Upper $\frac{3}{4}$ part covered with woolly hairs, lower $\frac{1}{4}$ shining with sparse hairs, leathery
3. Glume veins ..	Light green	Dark green
4. Lemma and palea	Reduced size	Normal size
5. Anthers ..	Do not exert probably due to failure of mechanism	Exert normally
6. Ovary and bifid stigma	Absent	Present

Complete sterility scattered in sectors at different locations in the earhead was also observed in other five male-sterile lines, *viz.*, AMS 1, AMS 2, AMS 3, AMS 4 and AMS 5 but it was not observed in their respective maintainer lines. It is likely that male-sterility in these types might have been induced by utilising C.K. 60 A cytoplasm. In order to overcome such condition it is necessary to have a different cytoplasmic male-sterile line.

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NOTES ON *BANCHOPSIS RUFICORNIS* CAMERON (HYM. : ICHNEUMONIDAE) AN INTERNAL LARVAL PARASITE OF *HELIOTHIS ARMIGERA* (HÜBNER) IN INDIA*

IN March 1963, *Banchopsis ruficornis* Cameron was reared from full-grown larvæ of *Heliothis armigera* (Hübner) feeding on gram (*Cicer arietinum* L.) at Sriganganagar (Rajasthan) and this is the first host record for this species.

Parasitism in the field was then 6·16%, and the parasite was obtained in small numbers from the field-collected host larvæ until the second week of April, by which time, parasitism had declined to 1 to 1·6%. This parasite was also reared from *H. armigera* at Bangalore (Mysore State), Ludhiana and Jullundur (Punjab) in 1964 and at Kulu (Himachal Pradesh) in August 1965. From parasite cocoons sent to Bangalore from Sriganganagar in 1963 a single adult emerged in 1965, after 22 months. According to Townes *et al.* (1961) this species was described in 1905 as *Ephonites ruficornis* Cameron and occurs in India and Pakistan. Other synonyms described by them are *Eponites scutellaris* and *Eponites ruficornis*.

At Jullundur cocoons formed in March and April 1965 were kept under observation in the laboratory. Adults started emerging in the third week of February 1966. From 1,092 larvæ of *Heliothis* collected in March, 113 parasites were reared, parasitism being 10·4%. Adults were common in the field at Jugaron (Jullundur District) in mid-March and were collected in large numbers for study. Adults in the laboratory fed on diluted honey lived a maximum of 35 days. They became scarce in April, but specimens were reared from the field-collected larvæ until the end of the month.

Immediately after emergence, females mated readily with 2- or 3-day-old males in cages or in glass vials. Copulation lasted from 3 to 7 minutes. Females started stinging hosts about 2 days after mating, but host larvæ thus stung, pupated normally and completed their development. Only after a further day were host larvæ successfully parasitised. Mated females were kept in a 1' × 1' × 1' cage with a glass sliding front, glass sides and a muslin top with a sleeve. Honey swabs were fixed to the muslin as food. High humidity was maintained by placing a wet sponge at the bottom of the cage. Small *Heliothis* larvæ (4 to 8 days old) were placed inside the cage singly for parasitisation either on gram leaves or on the tip of a brush, and the cage kept in front of a table lamp. These larvæ were quickly stung and parasitised, and then removed to glass vials and provided with tender gram leaves which were changed daily. As the larvæ developed they were fed on soaked gram seeds, but they stopped feeding 4 to 5 days prior to the emergence of the parasite larvæ from their bodies, by which time the parasite larvæ had consumed the host body contents and could be easily seen through the host's skin. Emergence

of parasite larvæ took place 17-19 days after oviposition and they were then wrapped in cotton and replaced in glass vials, where they readily formed drum-shaped cocoons within 24 hours. These cocoons, which had thick and tough walls, were kept for emergence in a petri-dish placed on a moist sponge in a polythene jar. There is only one generation per year and emergence occurred in late February the following year, the parasite being in larval diapause in the cocoon.

In spite of repeated search no parasite cocoons were found in the field. In the laboratory parasite larvæ in a petri-dish entered the soil and formed cocoons there. It appears that cocoons may normally be formed in the soil and remain buried in it during various cultural operations.

The author is grateful to Mr. E. O. Pearson, Director, Commonwealth Institute of Entomology, for identifying the parasite and to Dr. V. P. Rao, Entomologist-in-charge, Indian Station of CIBC, for the valuable suggestions given during the course of this study.

Commonwealth Institute of   K. C. MATHUR.
   Biological Control, Indian Station,
Bangalore (India), *January* 27, 1967.

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1. Townes, H., Townes, M. and Gupta, V. K., *A Catalogue and Reclassification of the Indo-Australian Ichneumonidæ*, Michigan, U.S.A., 1961, p. 212.

STOMATAL ABNORMALITIES IN TWO DICOTYLEDONS

ALTHOUGH extensive information is available on abnormalities of major plant organs (like stem, leaf, flower, etc.), little is known of similar modifications of minor organelles. The authors describe here some abnormal forms of stomata observed in *Momordica charantia* L. (Cucurbitaceæ) and *Scœvola frutescens* Krause (Goodeniaceæ). In the Cucurbitaceæ, stomata of about 50 species were studied by the authors, but only in the above one member the said abnormalities have been noticed. Occurrence of aberrant stomata in *Scœvola* was noted later.

Momordica charantia.—Normal stomata are anomocytic (Fig. 1) and occur on the stem, tendril, leaf (both surfaces) pedicel, calyx (both surfaces), corolla, (only abaxially), stamens (only on the connective) and the ovary. It is the stomata borne by the connective that show bizarre structure and those which are extremely modified seem out of recognition.

The altered forms of stomata are of regular occurrence and are found mixed with the normal ones. The abnormality is due to unusual proliferation of the guard cells and their irregular arrangement (Figs. 2-5). The proliferation itself can be recognised to be of two kinds. In one the guard cells subdivide several times, in longitudinal and other directions and give rise to a cluster of guard cells of the parent size with pores in between (Fig. 4). In the extreme formations of this kind, the guard cells as such are not recognisable (Fig. 5).

FIGS. 1-8. Figs. 1-5. From *Momordica charantia*: Fig. 1. From leaf lower epidermis. Figs. 2-5. From the connective. Figs. 6-8. From the leaf lower epidermis of *Scœvola frutescens*.

In the second one the guard cells proliferate small-sized stomata through their subdivision and give rise to miniature stomata (Figs. 2 and 3). In these formations the newly formed stomata although smaller in size are distinctive unlike in the above.

Scœvola frutescens.—The stomata are anomocytic (Fig. 6 *a*), as they are surrounded by 3-5 cells of the same size. Some of the stomata approach anisocytic condition as they show only three subsidiary cells, one relatively smaller than the others (Fig. 6 *b*). Stomata are borne by this plant on its stem (extremely rare), leaf (both surfaces), peduncle, pedicel,

calyx (both surfaces), corolla (only abaxially and confined to the greenish midrib areas of the petal lobes) and the ovary. The stamens, style and stigma are non-stomatiferous. It is on the leaves and particularly on their lower surface that the abnormalities are observed. The abnormal forms are only sporadic unlike in *Momordica charantia,* and are scattered among the normal ones.

The two categories of abnormalities described for *Momordica charantia* are also observed in this species. The first category which consists of islets of numerous stomata of the parent size is seen in Fig. 8, but the extremely bizarre formations noted in *Momordica charantia* have not been seen. The second category in which miniature stomata are produced by the normal guard cells is shown by Fig. 7.

Phylogenetically the abnormalities described do not suggest to be of any value because of their bizarre structure, but morphogenetically are significant. They could be considered to arise due to a momentary disturbance in the factors controlling the normal stomatal development.

The authors' thanks are due to Prof. M. R. Suxena for his kind interest and encouragement.

Department of Botany,   B. RAJESWARA RAO.
Osmania University,   N. RAMAYYA.
Hyderabad-7 (A.P.), *February* 1, 1967.

A NOTE ON THE GERMINATION OF HETEROCYSTS IN *ANABAENA NAVICULOIDES* FRITSCH

GERMINATION of heterocysts, although a rare phenomenon, has been sporadically recorded in a few Myophyceæ (Desikachary).[1] It has been known in three species of the genus *Anabœna,* viz., *A. variabilis* Kuetz.[2] [including *A. hallensis* (Jancz.) Born *et* Flah.], *A. steloides* Canabaeus[3] and *A. cylindrica* Lemm.[4] The object of the present communication is to record the germination of heterocysts in another species, *i.e., A. naviculoides* Fritsch. The last-named species was isolated[5] in culture from the paddy field soils of the Ghazipur District of Uttar Pradesh.

The stages of germination of the heterocysts were observed in a four-months old culture of the alga grown in liquid De's[6] medium. Both terminal and intercalary heterocysts occur in the alga. Some heterocysts were found empty while some others showed remnants of their contents. There were yet several others in which the contents had contracted from the side walls and in some cases, stages of division of the contents were noticed (Figs. 1-3). Two-celled stages within the intact heterocysts were commonly observed but further stages of cell

division of the heterocysts were not seen. However, two-celled (Fig. 5) and four-celled (Fig. 6) germlings were seen emerging from the ruptured side walls of the heterocysts. Sometimes only one cell out of the pair formed within the heterocyst remained healthy while the other looked moribund (Fig. 4). The presence of polar nodules and the thick wall of the heterocyst could be made out at every stage.

FIGS. 1-6. *Anabœna naviculoides* Fritsch. Figs. 1-2. Intercalary heterocysts showing stages in division of the cell contents. Fig. 3. Intercalary heterocyst showing a two-celled germling. Fig. 4. Degeneration of one cell in the two-celled stage. Figs. 5-6. Intercalary heterocysts, showing rupture of side-wall and liberation of two-and four-celled germlings.

This phenomenon of germination of heterocysts also points to the fact that under certain conditions, immature heterocysts retain the potentiality of germination even though polar nodules and a thick wall might have been formed. However, mature heterocysts in which the contents have completely disappeared are incapable of germination. It may be mentioned here that in this species under cultural conditions akinetes germinate at all stages of development and appear to have no definite resting period.

Thanks are due to Dr. A. K. Mitra for guidance and interest in the preparation of this paper.

Department of Botany,   D. C. PANDEY.
Univ. of Allahabad (India),
November 17, 1966.

1. Desikachary, T. V., *Cyanophyta,* I.C.A.R., New Delhi, 1959.
2. Geitler, L., Cyanophyceæ in Rabenhorst's *Kryptogamenflora,* Leipzig 1932. p. 14.
3. Canabaeus, L., *Pflanzenforschung,* Jena, 1929, **13,** 140.
4. Fogg, G. E., *Ann. Bot.,* n.s., 1949. **13,** 251.
5. Pandey, D. C., *D. Phil Thesis,* Allahabad University, 1962.
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CHROMOSOME NUMBER IN TASAR SILKWORM *ANTHERAEA MYLITTA* DRURY

LEPIDOPTERA have proved less attractive for cytological studies as their chromosomes are small, round and numerous. The chromosome numbers of the Lepidopterous larvæ producing the silk of commerce have mostly been elucidated, leaving behind a few Indian species of the genus *Antherœa*. One of the more important indigenous species is *Antherœa mylitta* D. which produces the popular Tasar silk. This is a highly heterogeneous species distributed throughout North and Central India. A detailed cytogenetical study is therefore required to understand the heterogenity prevailing among *Antherœa* species, so far as their taxonomy, hybrids between species and different zonal races are concerned.

The chromosome number in different sericigenous insects of commercial interest worked out so far is given in Table I.

yamamai. Qualitative chromosomal variations between different species of the same animal are however not rare. *Antherœa mylitta* is being cultured in India for centuries. The geographical barriers and varied climatic condi-

FIG. 1. Polar view of metaphase showing haploid number of chromosomes of *A. mylitta* ($n = 31$), ×25,600.

TABLE I

Name of the sericigenous insects		Haploid chromosome number	Author	Year
Family—*Bombycidæ*				
Bombyx mori L.	..	28	Tanaka and Kawaguchi	1881
Theophila religiosœ Helf.	..	31	Tazima *et al.*	1959
Bombyx (Theophila) mandarina Moore		27	Yatsu	1913
Bombyx (Theophila) mandarina Moore		28	Astaurov *et al.*	1959
Family—*Saturniidæ*				
Attacus ricini	..	14	Deodikar and Thakar	1958
Antherœa pernyi G.M.	..	49	Kawaguchi	1933–'34
Antherœa yamamai G.M.	..	31	Kawaguchi	1933–'34
Antherœa assamensis Westwood	..	15	Deodikar *et al.*	1962
A. peryni × *A. yamamai*	..	68–69	Kawaguchi	1933–'34

* Quoted by Makino.

As far as Indian *Antherœa* species yielding Tasar silk (*Antherœa mylitta*) is concerned, attempts to study its chromosome number for the first time was made in this Research Station.

Testes from healthy male larvæ, 5 to 6 days after the fourth moult were dissected out in physiological saline and fixed overnight in acetic-alcohol (1 : 3). Counts were made from temporary aceto-carmine squashes of the testes and the chromosomes were counted at a magnification of 100×16.

Polar views of the metaphases (Fig. 1) have shown 31 distinct bivalents which are nearly spherical in shape and show little difference in their relative size. The results have been verified in numerous subsequent preparations. *Antherœa mylitta* Drury has a haploid chromosome number of $n = 31$ which accidentally conforms with that of the Japanese form *Antherœa*

tions have produced ecological races. Variation in chromosome constitution may therefore be expected in these races.

Studies with different Indian *Antherœa* species and their hybrids now in progress may reveal interesting results.

Central Tasar Research   S. S. SINHA.
    Station, Hehal,   M. S. JOLLY.
Ranchi (Bihar), *January* 27, 1967.

1. Astaurov, B. L., Garisheba, M. D. and Radinskaya, I. S., *Cytology*, 1959, **1** (3), 327 (R).
2. Deodikar, G. B. and Thakar, C. V., *Curr. Sci.*, 1958, **27**, 457.
3. —, Chowdhury, S. N., Bhuyan, B. N. and Kshirsagar, K. K., *Ibid.*, June 1962, **31**, 247.
4. Makino, S., *A Review of Chromosome Numbers in Animals*, Hokuryukan, Tokyo, 1956, pp. 102, 110.
5. Tazima, Y., *The Genetics of the Silkworm*, National Institute of Genetics, Japan, 1964, p. 1.

REVIEWS AND NOTICES OF BOOKS

Fluctuations of Stationary and Non-Stationary Electron Currents. By C. S. Bull. (Butterworths, London), 1966. Pp. xiii + 217. Price 68 *sh.*

The material presented in this book originated from research on the noise of valves but in physics fluctuations are a topic of considerable fundamental importance in their own right. The method of specifying the stationary or non-stationary state of the circuit can be put into very general form, and should be applicable to other irreversible systems, such as the flow of a gas or even the spread of an epidemic.

In the first three chapters the theory of electricity is discussed with the aim of supporting the hypothesis that the electric field is discontinuous, and examining in detail the consequences of this hypothesis.

After clarifying the necessary mathematical methods, the author goes on to discuss various kinds of electrical fluctuation. Under-graduates will find this critical discussion of field theory and fluctuation theory interesting.

In the remaining chapters, six important topics are examined in depth. This original and stimulating book will be of interest not only to electronics research workers, but also to all who are concerned with the merits and demerits of continuous and discontinuous methods in physics.   C. V. R.

Annual Review of Entomology (Vol. 12). Edited by R. F. Smith and T. E. Mittler. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, U.S.A.), 1967. Pp. 563. Price $8.50 (U.S.A.) and $9.00 (elsewhere).

The titles of the articles contained in this volume are as follows: The Entomologist, J. C. Fabricius; Temperature Effects on Embryonic Development in Insects; Gut Absorption; Food Selection by Grasshoppers; Bionomics and Ecology of Predaceous Coccinellidæ; Fungal-Insect Mutualism in Trees and Timber; Systemic Insecticides in Trees; Insects and the Problem of Austral Disjunctive Distribution; The Evolution and Past Dispersal of the Trichoptera; Evaluation on Forest Insect Infestations; Mode of Action of Insecticide Synergists; Consequences of Insecticide Use on Non-target Organisms; A Critical Review of *Bacillus thuringiensis* var. *thuringiensis* Berliner and

Other Crystalliferous Bacteria; Allergic Responses to Insects; *Trans*-Stadial and *Trans*-ovarial Development of Disease Agents in Arthropods; Ticks in Relation to Human Diseases Caused by *Rickettsia* Species; Recent Fundamental Work on Tsetse Flies; Recent Advances in Bee Communication and Orientation; The Evolution and Genetics of Insect Behaviour; and Acoustical Communication in Arthropods.   C. V. R.

Metallurgical Society Conferences (Vol. 33)— *Beryllium Technology.* Edited by L. McDonald Schetky and Henry A. Johnson. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011).

Volume 1, 1966. Pp. xii + 678. Price: Paper, $19.00; Cloth, $35.00.

Volume 2, 1966. Pp. xii + 578 (*i.e.*, 679 to 1255). Price: Paper, $19.00; Cloth, $35.00.

The first international symposium on beryllium technology was held in England under the auspices of the Institute of Metals, in the fall of 1961. In the ensuing period, the technology and applications of this metal have moved from the nuclear power orientation, which was prevalent at that time, to one which now emphasizes aerospace and instrumentation applications. Accordingly, it was felt timely that a second conference, international in scope, should be organized to bring into focus these new developments.

In the period from 1961 to 1964, while still vigorously pursuing research on the fundamental physical metallurgical phenomena underlining the brittle behavior of beryllium many new and useful variations of this metal have been produced. High oxide content material has proven of advantage for precise stable space navigation systems, while new aluminium-beryllium composite materials show promise for aerospace structures.

Volumes 1 and 2 represent the Proceedings of the Second International Conference sponsored by the Nonferrous Committee of the Institute of Metals Division, The Metallurgical Society, American Institute of Mining, Metallurgical and Petroleum Engineers, Philadelphia, Pennsylvania, October 15-17, 1964. The program was divided into four broad areas: I. Purification and Alloying Studies; II. Physical

Metallurgy; III. Mechanical and Process Metallurgy; and IV. Design and Application of Beryllium Structures.

In the latter portion of the conference, we see actual production structures and examples of the engineering design of complex shapes in a material which has many property disadvantages which had to be circumvented.

The conference was attended by a broad segment of international scientists and engineers and therefore constitutes an excellent summary of the current state of beryllium technology.
C. V. R.

Transients in Power Systems. By Harold A. Peterson. (Dover Publications, Inc., 180, Varick Street, New York, N.Y. 10014), 1966. Pp. xi + 361. Price $ 3.00.

This Dover edition, first published in 1966, is an unabridged and slightly corrected republication of the work originally published by John Wiley and Sons, Inc., New York, in 1951.

The contents of this book are : 1. Overvoltages during Power System Faults ; 2. Effect of Saliency on Overvoltages during Faults ; 3. System Voltage Recovery Characteristics— Fundamental Concepts ; 4. System Voltage Recovery Characteristics—Miniature-System Approach ; 5. Effects of Arc Restriking on Recovery Voltage ; 6. Switching Surges—Capacitive Ciruits ; 7. Switching Surges and Overvoltage Arrester Discharge Requirements ; 8. Overvoltages Caused by Sudden Loss of Load ; 9. Overvoltages Caused by Open Conductors ; and 10. Some Additional Non-Linear Circuits.
C. V. R.

High Vacuum Technology. By L. Ward and J. P. Bunn. [Butterworth and Co. (Publishers) Ltd., 88, Kingsway, W.C. 2, London], 1967. Pp. 216. Price 48 *sh.*

The book is a readable and dependable introductory text on the theory and practice of vacuum technology. It presents a general survey of the principles underlying vacuum technology, and includes modern trends in the development and applications of high vacuum techniques. The earlier chapters deal with the general theory of gaseous flow, and the production and measurement of low pressure. These are followed by chapters on construction of vacuum systems, their operation and design, and leaks and leak detection. The chapter on applications includes vacuum coating, manufacture of filament lamps, discharge lamps, and electron tubes, use of vacuum technique in

metallurgical processes, and simulation of outer space and high altitude environments.

The book is profusely illustrated and it can be recommended as a suitable introductory textbook to under-gaduate students in colleges of technology, and also to laboratory workers dealing with high vacuum problems.
A. S. G.

Books Received

The Gaseous State. By N. G. Personage. (Pergamon Press, Oxford), 1966. Pp. xvi + 170. Price 18 *sh.* 6 *d.*

Physical Principles of Magnetism. By F. Brailsford. (D. Van Nostrand Co., Ltd., London W. 14), 1966. Pp. x + 274.

Introduction to Microscopy. By G. W. White. [Butterworth and Co. (Publishers), London W.C. 2], 1966. Pp. vii + 255. Price 30 *sh.*

Vibrations, Waves and Diffraction. By H. J. J. Braddick. [McGraw-Hill Publishing Co., Ltd., Maidenhead, Berkshire (England)], 1965. Pp. x + 217. Price 36 *sh.*

Engineering Kinematics. By Alvin Sloane. (Dover Publications, New York), 1966. Pp. 310. Price $ 2.25.

The Theory of Equilibrium of Elastic Systems and its Applications. C. A. Pio Castigliano. (Dover Publications, New York), 1966. Pp. lxiv + 360. Price $ 3.00.

Microwave Spectroscopy. By W. Gordy, W. V. Smith, R. F. Trambarulo. (Dover Publications, New York), 1966. Pp. xii + 446. Price $ 3.00.

A Simple Approach to Electronic Computers (2nd Edition). By E. H. W. Hersee. (Gordon and Breach, New York), 1967. Pp. xi + 261. Price $ 7.50.

ANNOUNCEMENTS

Award of Research Degrees

Andhra University has awarded the Ph.D. degree to the following : (Mrs.) D. V. Lalitha (Physics) and Sri. C. V. Reddy Sastry (Chemistry).

Sri Venkateswara University has awarded the Ph.D. degree to the following: Sri. S. Raghupathi Rami Reddy (Zoology), Sri. C. V. R. K. Prasad (Geology), Smt. A. V. Satyavati (Physics) and Smt. Nayeemunnisa (Zoology).

Roster of Indian Scientific and Technical Translators

This *Roster* compiled by the Indian National Scientific Documentation Centre (INSDOC) contains the names and addresses of 603 translators in India who are proficient in one or

more of 28 foreign languages (other than English and the Indian languages) for translation work of scientific and technological subjects. The purpose of the publication is to assess the translation potential in India which has become necessary with the rapid developments in science and technology taking place in the country.

The *Roster* is not a priced publication. Interested libraries and institutions can get a copy free of cost on request to the Director, Insdoc, Hillside Road, New Delhi-12.

Second FAO Technical Conference on Fishery Research Craft

The above conference will be held at the Pacific Science Centre, Seattle, Washington, U.S.A., on 11–15 December 1967. The theme of the Conference is *Modern Fishery Research Craft*. The emphasis will be on unusual, advanced and integrated craft for fisheries research and especially how problems in data collection and data processing can be solved. Call for papers has been issued and further information can be obtained from Mr. Jan-Olof Traung, Chief, Fishing Vessel Section, Fishery Resources and Exploitation Division, FAO, Rome, Italy.

Fourth International Conference on Atmospheric Electricity

The Fourth International Conference on Atmospheric Electricity will be convened in Tokyo from May 12 to 18, 1968. It is planned to hold a one-day joint session on "Space Electricity" with COSPAR, which will also meet in Tokyo at that time.

Chairman S. C. Coronith (AVCO Corporation, Space Systems Division, 201, Lowell Street, Wilmington, Mass. 01887, U.S.A.), invites participants to submit concise, but complete papers not later than 15 September 1967.

Czechoslovak Society of Arts and Sciences in America

Preparations are under way for the Fourth Congress of the Society which will be held in the late summer or early fall of 1968. Requests for information concerning the forthcoming Congress or other activities of the Society, including its publication, may be addressed to Dr. M. Recheigl, Jr., 1703, Mark Lane, Rockville, Md. 20852, U.S.A.

World Action for Population Control

Population control, a matter of top priority for India, is getting the determined attention of the pharmaceutical industry of the world. Pre-eminent in this field are The British Drug Houses Ltd. Lt.-General S. P. Bhatia, Vice-Chairman of B.D.H. India, who has just returned from the U.K. where he acquainted himself with the latest developments in the family planning techniques and met leading authorities on the subject, said that the safety and effectiveness of new contraceptives are under constant and rigid study. "The key to solving the problem of over-population" feels General Bhatia, "lies with world governments who are sufficiently far-seeing to appreciate the urgency of the threat of population explosion". The B.D.H.'s expansion plans in India for pharmaceutical chemicals include manufacturing facilities for the steroid megestrol acetate which is an active constituent in their oral contraceptives (*British Drug Houses News*).

Lady Tata Memorial Trust : Scholarships and Grants for the Year 1967-68

The Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1967, the awards of scholarships and grants for the year 1967-68.

International Awards of varying amounts (totalling £ 6,200) for research in diseases of the blood with special reference to Leukaemias are made to: Dr. V. Balazs (Holland); Dr. M. Frohlich (Holland); Dr. R. Hancock (Switzerland); Dr. L. Mazzarella (Italy); Dr. J. Reviron (France); Dr. D. Viza (France); Dr. (Mrs.) E. Davidson (Great Britain); and Miss A. M. Tomkys (Great Britain).

Indian Scholarships of Rs. 300 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to: Dr. (Miss) Usha C. Parekh (Bombay); Dr. Anjan Chakraborty (Kanpur); Dr. M. K. Jain (Bombay); Mr. C. Dwivedi (Gorakhpur); Mr. H. Sheik Alludeen (Bangalore); Mrs. Mohini A. Jayavant (Bombay); and Miss K. N. Rangnekar (Bombay).

Correction

Several typographical corrections could not be included at the last stage in the article "Fourier Treatment of the Anomalous Dispersion Corrections in X-Ray Diffraction Data" by R. Srinivasan and K. K. Chacko, published in *Curr. Sci.*, June 5, 1967, page 279. Corrected copies are available as reprints and can be had from the authors.

THE MAJOR ALKALOID OF *CROTALARIA LABURNIFOLIA* SEEDS

R. N. GANDHI, T. R. RAJAGOPALAN AND T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

THE seeds of *Crotalaria laburnifolia* have been in use as a cure for snake and scorpion bites.[1] They were earlier reported[2] to contain an alkaloid with m.p. 184–186° (d) and molecular formula $C_{16}H_{23}O_5N$. Later Subramanian et al.[3] confirmed its occurrence and named it Crotalaburnine. They also recorded the presence of β-sitosterol and lutexin in the seeds.

In view of the importance of the drug, a detailed study of the alkaloid components was considered necessary. We have therefore examined the seeds procured from Kerala State. The following method of extraction has now been adopted.

The coarsely powdered seeds (2 kg.) were percolated with hot ethanol and the percolate concentrated to small bulk. It was acidified with an equal volume of 10% aqueous citric acid and the remaining ethanol distilled off under reduced pressure. After extraction with petroleum-ether and ether to remove waxes, sterols and fatty components, the solution was made basic with ammonia and the alkaloids extracted exhaustively with chloroform. The extract was dried and evaporated yielding a yellowish residue which gave an orange-red precipitate with Dragendorff reagent. Its solution in acetic anhydride was pale yellow and remained unchanged on boiling, showing the absence of N-oxides. T.L.C. (silica gel G) of the residue using methanol as solvent gave four spots, one of which belonged to a predominantly major component. When the residue was crystallised twice from absolute ethanol, it yielded the major alkaloid as colourless plates (T.L.C. single), m.p. 197–199°(d); yield 4·0 g; $[\alpha]_D^{25}$, + 29·7 (abs. ethanol), $[\alpha]_D^{25}$, − 19·0 (chloroform). We tentatively retain the name crotalaburnine for the pure alkaloid. It formed a golden-yellow picrate, m.p. 222–224° (d) and a colourless methiodide, m.p. 220–222°(d). The elemental analysis of the pure alkaloid and its m.wt. (Rast) agreed with the formula $C_{18}H_{25}O_6N$. It had no methoxyl but had three C-methyl groups. The i.r. spectrum (KBr) showed saturated and unsaturated ester carbonyls at 1750 and 1720 cm.$^{-1}$ respectively and hydroxyl at 3500, 3620 cm.$^{-1}$.

On hydrolysis with aqueous barium hydroxide crotalaburnine gave a necic acid which crystallised from ethylacetate and petroleum-ether, m.p. 144–145°; $[\alpha]_D^{26}$, + 9·8 (abs. ethanol). It had the composition $C_{10}H_{16}O_5$, i.r. (KBr) showed hydroxyl at 3600 and carbonyl at 1720,

1740 cm.$^{-1}$. In all these properties it agreed closely with senecic acid. [Lit.[4] m.p. for senecic acid, 146° and $[\alpha]_D^{25}$, + 10·9 (abs. ethanol)]. The identity was confirmed by converting it into lactone, m.p. 153–154°, $[\alpha]_D^{26}$, + 37·1 (abs. ethanol). [Lit.[4] m.p. for senecic acid lactone 156° and $[\alpha]_D^{25}$, + 36·5° (abs. ethanol)]. Using a sample of senecic acid kindly supplied by Dr. C. C. J. Culvenor direct comparison has been made; m.m.p. was undepressed and i.r. spectra were identical.

The necine obtained by the hydrolysis of the alkaloid crystallised from absolute ethanol as colourless prisms, m.p. 195°(d), $[\alpha]_D^{26}$, + 38·8 (abs. ethanol). Its elemental analysis agrees with the formula $C_8H_{13}O_3N$; i.r. (KBr) showed hydroxyl at 3510 cm.$^{-1}$.

The alkaloid on hydrogenolysis using PtO_2 catalyst in absolute ethanol gave a product which crystallised from absolute ethanol, m.p. 179–180°(d); $[\alpha]_D^{34}$, − 20·0 (chloroform). Its elemental analysis agrees with the formula $C_{18}H_{29}O_6N$. It has four C-methyls, i.r. (KBr) showed hydroxyl at 3580, carbonyl at 1720 and an absorption characteristic of a zwitter ion at 1610 cm.$^{-1}$. The reduction has therefore split only one of the ester groups as earlier known in the case of several senecio alkaloids.

Based upon the above evidence the major alkaloid from *Crotalaria laburnifolia* is a cyclic diester of the pyrrolizidine group with senecic acid as the acid part, the necine ($C_8H_{13}O_3N$) having hydroxymethyl group in the 1-position and a hydroxyl in the 7-position; the position of the 3rd hydroxyl is unsettled. Recently Culvenor et al.[5] isolated an alkaloid anacrotine from *Crotalaria anagyroides* seeds, yielding crotanecine and senecic acid on hydrolysis. Only partial data are available on this alkaloid and necine. There is considerable resemblance in properties between this pair and crotalaburnine and its necine, though there are some differences also (m.p. and i.r.). The n.m.r. spectra have great similarity but more data will be required to establish identity or otherwise and work is in progress with this end in view.

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2

ORIENTIN AND ISO-ORIENTIN FROM THE SEEDS OF
CROTALARIA LABURNIFOLIA LINN.

S. SANKARA SUBRAMANIAN AND S. NAGARAJAN
Jawaharlal Institute of Post-Graduate Medical Education and Research, Pondicherry-6

IN an earlier communication[1] from our labo-
ratories, the isolation of orientin (lutexin),
8-C-glycosyl luteolin from the dehusked powder
of the seeds of *Crotalaria laburnifolia* (Legumi-
nosæ) was reported for the first time, and in
continuation of that work we wish to record
the results of our chemical investigation of the
whole seeds in detail for other flavonoids
present, since the husk portion of the seeds
answered positive tests for this type of pigments.
Further, the isolation of iso-vitexin from the
fresh seeds of *C. anagyroides* has been recently
reported[2] by us.

Dry seeds of *C. laburnifolia* (coarsely
powdered in a Wiley cutter-mill in preference
to disc grinders to avoid heating during com-
minution) were extracted four times with hot
ethanol (80%) under reflux, and the total
extract concentrated *in vacuo* till all the alcohol
was removed. The aqueous concentrate was
repeatedly shaken with light petroleum, ether,
ethyl acetate and methyl ethyl ketone in suc-
cession. The fatty matter and carotenoid
pigments were removed by light petroleum and
ether, and the subsequent ethyl acetate and
methyl ethyl ketone layers contained the
flavonoid glycosides. The residue from the
ethyl acetate extract was dissolved in hot
ethanol and allowed to remain in an ice-chest
for two days, when yellow crystalline solid,
m.p. 255–57° was obtained (yield: 0·02%).
This was identified as orientin by its colour
reactions, behaviour on paper chromatography
in different solvent systems, resistance to usual
acid hydrolysis and direct comparison with an
authentic sample of the compound earlier iso-
lated.[1] The mother liquor was diluted with a
little water and left in an ice-chest. After
about two months, some yellow solid separated.
This was twice recrystallised from aqueous
alcohol, when dull yellow crystals, m.p. 235–37°,
were obtained. It gave all colour reactions for
a flavonoid glycoside and on hydrolysis with
aqueous alcoholic sulphuric acid (7%), it gave
quercetin (identified by direct comparison with
an authentic sample and its acetate) and
galactose (identified by paper chromatography).
The glycoside as such could not be fully
characterised for want of sufficient quantity of
the pigment.

The residue from the methyl ethyl ketone
extract was taken up in hot methanol and left
in the ice-chest for about a week, when yellow
crystalline solid was obtained. This was
recrystallised twice from hot methanol, when
yellow needles melting at 240–42° were obtained
(yield, 0·1%). This could not be hydrolysed
with 7% sulphuric acid in aqueous alcoholic
medium for eight hours as well as with 25%
hydrochloric acid. On paper chromatography
in different solvent systems, it gave R_f values
(Table I) agreeing with those of an authentic
sample of iso-orientin,[3] and the colour reactions
of the compound now isolated and iso-orientin
were the same. The identity of the pigment as
iso-orientin 6-c-glucosyl luteolin was further
confirmed by IR and NMR spectra of our sample
and an authentic sample of iso-orientin (homo-
orientin), at the Institute of Pharmaceutical
Sciences of the University of Munich, and
hydrolysis with hydriodic acid in phenol to give
luteolin.

TABLE I
Chromatography of the pigment from
C. laburnifolia and authentic iso-orientin

(Whatman No. 1 paper, ascending, temp. 30° ± 2°)

Solvent system		R_f values	
		Pigment from *C. laburnifolia*	iso-orientin (authentic)
15% acetic acid	..	·36	·36
60% ,,	..	·65	·65
*BAW 4 : 1 : 2	..	·45	·45
*BAW 4 : 1 : 5 (upper)	..	·45	·46
*BAW 6 : 1 : 2	..	·46	·46
Phenol saturated with water (lower)		·67	·67
†EFW	..	·66	·66
‡AHW	..	·74	·73
n Butanol : 27% acetic acid (1 : 1)		·49	·48

*BAW : *n*-Butanol : acetic acid : water.
†EFW : Ethyl acetate : formic acid : water (10 : 2 : 3).
‡AHW : Acetic acid : conc. hydrochloric acid : water
(30 : 3 : 10).

Besides these flavonoids and the major
alkaloid (Crotalaburnine) reported earlier,[1]
we have detected 3 minor alkaloids by means
of paper chromatography and thin layer
chromatography on silica gel (Table II).

TABLE II
Chromatography of the alkaloids of C. laburnifolia

Solvent system	R_f values*	
	Crota-laburnine (major)	Minor alkaloids
Paper, Whatman No. 1, ascending		
1. *n*-Butanol saturated 5% acetic acid (upper phase)	0·61	0·20, 0·32, 0·50
2. *n*-Butanol : ammoria : water (30 : 1 : 5)	0·80	0·37, 0·51, 0·69
TLC—silica gel G-2 mm.		
1. Chloroform : methanol : ammonia (85 : 14 : 1)	0·55	0·08, 0·31, 0·67

* Spraying reagent : Dragendroff's (Munier modification).

It is interesting to note that the seeds of *C. laburnifolia* contain the flavonoid C-glycosides, orientin and iso-orientin and an O-glycoside of quercetin, whose occurrence in *Crotalaria* genus is reported for the first time. It may be mentioned here that the co-occurrence of orientin and hyperoside (quercetin 3-galactoside) in *Sarothamnus scoparius* (Papilionatæ) has been earlier recorded by Hörhammer *et al.*[4]

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VIBRATIONAL SPECTRA OF o-, m- AND p-FLUORO- AND BROMOBENZALDEHYDES

V. B. SINGH AND I. S. SINGH

Department of Spectroscopy, Banaras Hindu University, Varanasi-5   (India)

THE electronir absorption spectra of o-, m and p-fluoro- and bromobenzaldehydes in the visible and the near-ultraviolet regions have been reported by a number of earlier workers.[1-5] So far no work appears to have been carried out on the infrared and Raman spectra of the three isomeric bromobenzaldehydes. The vibrational spectral studies of the three isomeric fluorobenzaldehydes have been made by Chandra[6] and Srivastava *et al.*,[7] but none of them has presented the vibrational assignments for these compounds. We have, therefore, recorded the infrared absorption spectra of these six compounds in the region 400–4600 cm.$^{-1}$ and vibrational assignments have been made.

The infrared absorption spectra of the three isomeric fluorobenzaldehydes were recorded in the region 400–700 cm.$^{-1}$ on a Carl-Zeiss (Model UR 10) double beam infrared spectrophotometer using a thin film of pure liquid enclosed between two KBr windows, and the infrared spectra of o- and m-bromobenzaldehydes were recorded in the same region on a Perkin-Elmer infrared spectrophotometer (Model 21) with KBr prism using a 0·10 mm. cell. The infrared absorption spectra of the three isomeric fluorobenzaldehydes and o- and m-bromobenzaldehydes in the region 700–4600 cm.$^{-1}$ were recorded on a Perkin-Elmer spectrophotometer (Model 13 U) with NaCl prism using a 0·05 mm. cell. The infrared spectrum of p-bromobenzaldehyde was recorded in the region 700–4600 cm.$^{-1}$ on a Perkin-Elmer spectrophotometer (Model 13 U) with NaCl prism using KBr pellet technique. The accuracy of measurement is 2 cm.$^{-1}$ between 400–1500 cm.$^{-1}$, 4 cm.$^{-1}$ between 1500–3000 cm.$^{-1}$ and 10 cm.$^{-1}$ above 3000 cm.$^{-1}$.

Benzaldehyde[8] as also p-fluoro- and p-bromobenzaldehydes belong to C_{2v} point-group to a first approximation. The total number of 36 vibrations are divided into 13 a_1, 12 b_1, 4 a_2 and 7 b_2 classes, which are all allowed in the Raman spectrum and all but a_2 in infrared spectrum. On the reduction of symmetry the o- and m-fluoro- and o- and m-bromobenzaldehydes belong to C point-group and give 25 a' planar and 11 a'' non-planar vibrations.

TABLE I

Correlation of the vibrational frequencies of o-, m- and p-fluoro- and bromobenzaldehydes

Fluorobenzaldehydes						Bromobenzaldehydes						Assigned mode of vibration
Ortho		Meta		Para		Ortho		Meta		Para		
cm.$^{-1}$	Int.	cm.$^{-1}$	Int.	cm.$^{-1}$	Int.	cm.$^{-1}$	Int.	cm.$^{-1}$	Int.	cm.$^{-1}$	Int.	
3110	(7½)	3108	(8)	3097	(7½)	..	..	3073	(6)	3073	(7½)	C—H stretching
3085	(2)	3070	(7)	3073	(6½)	3035	(7½)					do.
2796	(7½)	2755	(8)	2745	(8½)	2776	(6)	2746	(8)	2775	(4)	C—H stretching (in CHO group)
1710	(10)	1708	(10)	1710	(10)	1708	(10)	1708	(10)	1705	(10)	C=O stretching
1627	(9½)	1600	(10)	1601	(10)	1592	(10)	1582	(10)	1585	(9½)	C=C stretching
1558	(9)	1567	(7)	1567	(6)	1577	(9½)	1551	(6)	1570	(9)	do.
1481	(10)	1481	(9½)	1508	(10)	1465	(9½)	1470	(9)	1480	(6)	do.
1404	(9½)	1394	(10)	1394	(10)	1400	(9½)	1386	(10)	1385	(5½)	do.
1347	(4)	1356	(4½)	1345	(5)	1347	(3)	1346	(3½)	1348	(3½)	do.
1310	(8½)	1316	(8½)	1309	(9½)	1297	(8)	1303	(7)	1292	(4)	C—H i.p. bending (in CHO group)
1275	(9½)	..	..	1298	(10)	1267	(10)	1280	(9½)	1244	(2)	C—H i.p. bending
1224	(9½)	1262	(10b)	1220	(10b)	..	..	..	..	..	..	C—F stretching
1154	(9)	1160	(9½)	1148	(10)	1163	(8)	1163	(9½)	1155	(6)	C—H i.p. bending
1116	(7)	1128	(10)	1114	(6)	1112	(7½)	1111	(3½)	1109	(3)	do.
1097	(9)	1077	(7)	1035	(5½)	1045	(9½)	1065	(9½)	1094	(3)	do.
1028	(6)	1004	(7½)	1095	(9½)	1029	(9½)	1006	(8)	1067	(8)	C—C stretching (ring breathing)
1006	(4)	1032	(4)	1012	(9)	1015	(8)	1027	(4)	1010	(5)	C—C—C i.p. bending
987	(2½)	982	(2)	970	(4)	955	(5)	992	(7)	972	(3)	C—H o.p. bending
954	(6)	958	(8½)	948	(4)	917	(4)	916	(sh)	952	(1½)	do.
876	(8½)	907	(7)	863	(8½)	870	(5)	880	(9½)	816	(8)	do.
842	(9)	882	(9½)	839	(9½b)	821	(9½)	853	(9)	834	(8)	C—CHO stretching
773	(9½)	778	(9½b)	..	..	759	(9½)	785	(10)	810	(8)	C—H o.p. bending
758	(5)	750	(9½)	773	(9)	..	..	..	..	..	..	C—F i.p. bending
697	(5½)	698	(9b)	697	(4½)	704	(9)	700	(9)	697	(5)	C—C—C o.p. bending
631	(5)	643	(8)	634	(3)	631	(9)	642	(10)	..	..	C—C—C i.p. bending
..	..	..	..	..	..	558	(3)	554	(5)	..	..	C—Br stretching
507	(4½)	520	(8)	507	(6)	..	..	..	..	..	..	C—F o.p. bending
..	..	..	..	..	..	471	(5½)	476	(4)	..	..	C—C—C i.p. bending
442	(3½)	441	(7)	422	(5½)	434	(5½)	427	(10)	..	..	C—C—C o.p. bending
265*	(1)	282*	(½)	308*	(1)	..	..	..	..	..	..	do.
205*	(2)	224*	(2)	210*	(2½)	..	..	..	..	..	..	C—CHO o.p. bending
126*	(5)	128*	(5)	..	..	..	..	..	..	..	..	C—CHO twisting?

sh = shoulder;   b = broad;   i.p. = in-plane;   o.p. = out-of-plane;   * These values are taken from Raman data.

The analysis of the bands and the assignments of the fundamental frequencies have mainly been done on the basis of comparison with those of similar molecules like chlorobenzaldehydes[9] and tolualdehydes.[10]

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FOLIAR AND CAULINE SCLEREIDS OF *SCIADOPITYS VERTICILLATA* AND *DACRYDIUM* Sp.

A. R. RAO AND MANJU MALAVIYA (MISS)

Botany Department, Lucknow University, Lucknow

SYSTEMATIC studies on the sclereid structure, distribution and ontogeny in a number of Indian Conifers[1-9] have already been made. In the present note are included some preliminary observations on the structure and distribution of sclereids in two extra Indian conifers, i.e., *Sciadopitys verticillata* Sieb. and Zucc. and *Dacrydium* sp. Usual techniques of Foster[10-11] were used for the investigation.

Sciadopitys verticillata

Kitamura[12] made quantitative and developmental studies of the foliar sclereids of *S. verticillata*. The present note gives further details about the structure and distribution of these foliar sclereids and also the form and development of the hitherto unreported cauline sclereids in this species.

Numerous astrosclereids, often profusely dichotomously branched occur diffusely scattered in the leaf mesophyll, concentrated more near the two vascular bundles (Fig. 1, Photo 1). These sclereids have a fairly thick, lignified, lamellated secondary wall devoid of any pits and an empty lumen which narrows down into the long, pointed or curved arms (Figs. 2-6). The sclereid initials grow by "intrusive" and "symplastic" growth, and later on develop secondary walls. Their development is exactly like what has been described by Kitamura.[12]

Cauline sclereids are exclusively brachysclereids and are absent in the primary stem, but present in small numbers in the secondary stem (Figs. 7 and 8). They occur generally in the region of secondary phloem either solitary or in small groups, are oval or squarish in form with empty lumen and thick, lignified, lamellated secondary walls devoid of pits (Figs. 9-11). Ontogenetic studies show that it is one of the phloem parenchyma cells which gradually loses the contents, becomes more or less empty and develops a highly lignified secondary wall (Figs. 12-14).

S. verticillata belongs to the family Taxodiaceæ and its sclereid features differ from those of the other genera of the same family, studied by us. In *Taxodium distichum*[13] only foliar sclereids occur and they are fusiform with homogeneous, unpitted secondary walls. In *Cryptomeria japonica*[1] both brachy and osteosclereids occur in the stem and cones, and have

tannin in their lumen. The lignified, lamellated, secondary walls are pitted. In *Cunninghamia lanceolata*[9] foliar, cauline and also strobilar

FIGS. 1-35. Figs. 1-14. *Sciadopitys verticillata*. Fig. 1. Diagrammatic representation of T.S. of leaf showing the distribution of sclereids, × 18. Figs. 2-5. Forms of sclereids from the leaf, × 20. Fig. 6. One magnified sclereid, × 92. Fig. 7. T.S. of stem showing the distribution of sclereids (diagrammatic), × 18. Fig. 8. Part of T.S. of stem showing the detailed structure, × 92. Figs. 9-11. Forms of sclereids from the stem, × 198. Figs. 12-14. Stages in the development of sclereids in the stem × 92. Figs. 14-35. *Dacrydium* sp. Fig. 15. T.S. of leaf showing the distribution of sclereids (diagrammatic), × 34. Figs. 16-23. Various forms of sclereids from leaf, × 100. Fig. 24. T.S. of stem showing the sclereid distribution (diagrammatic), × 34. Fig. 25. Part of the same showing the structural details, × 50. Figs. 26-28. Cortical sclereids of stem, × 106. Figs. 29-30. Bark sclereids of stem, × 106. Figs. 31-35. Stages in the development of sclereids in the stem, × 100. (*c*, cortex; *ct*, cell content; *ep*, epidermis; *f*, fibre; *gt*, ground tissue; *i*, initial; *l*, lumen; *n*, nucleus; *pc*, pit-canal; *ph*, phloem; *pl*, palisade; *pt*, protoplast; *rc*. resin-canal; *scl*. sclereid; *sph*, secondary phloem; *sw*, secondary wall; *sx*, secondary xylem; *tr*, transfusion tissue; *vb*. vascular bundle; *xy*, xylem.)

3

sclereids occur. They are tannin-bearing and have thick, lamellated and pitted secondary walls with characteristic protoplasmic processes. In *S. verticillata* foliar astrosclereids and cauline brachysclereids are found. There are no strobilar sclereids. They have unpitted secondary walls and an empty lumen. These differences in the structure and distribution of sclereids in the above genera are helpful in distinguishing them from one another in a sterile or fertile state. Incidentally they draw attention to the fact that sclereid features also can be of taxonomic significance.

Dacrydium SP.

Neither foliar nor cauline sclereids seem to have been reported so far in *Dacrydium*, a member of the Podocarpeæ. Foliar sclereids are of the brachy, osteo and astrosclereid type (Figs. 15-23, Photo 2). The latter two may also be curved and variously branched. The sclereids are mostly concentrated on the side of the xylem (Fig. 15) which is lateral in a transverse section of the bifacial leaf. A basal torsion in all the leaves examined is probably

PHOTOS 1-2. Photo 1. Cleared mount of leaf of *S. verticillata* showing numerous astrosclereids, × 64. Photo 2. Cleared mount of the leaf of *Dacrydium* sp. showing the different types of sclereids, × 93.

responsible for this unusual position which occurs in many other conifers.[14] The transfusion tissue however occurs in a diffuse way all round the vascular bundle, but is very much concentrated on the phloem and resin-canal side. The sclereids have an empty lumen and a lignified, lamellated, unpitted, thin secondary wall. The palisade sclereids are smaller in size than those of the spongy mesophyll.

The cauline sclereids number few in the cortex but are numerous in the bark region. They occur either singly or in small groups on the outer side of the phloem (Figs. 24 and 25). The cortical sclereids have generally empty lumen (Figs. 26-28) whereas the bark sclereids contain some deeply stainable substance (Figs. 29 and 30). The secondary wall of these sclereids is very thick, lignified, lamellated and traversed by some pit-canals (Figs. 26-30). The sclereid initials are differentiated from large, uninucleate cortical parenchyma cells with sparse granular protoplasmic contents (Fig. 31), developed after the secondary activity. A general increase in size, deposition of lignin, migration of nucleus towards the newly formed secondary wall, further "secondary sclerosis", initiation of pits (Figs. 32-35) are the steps which lead to the formation of the brachy-sclereids.

The foliar sclereids in the species of *Podocarpus*[+] studied so far are exclusively of the brachysclereid type and seem to be present only in those species where transfusion tissue is absent. In the leaves of the species of *Dacrydium* investigated, brachy, osteo and astrosclereids occur, with some transfusion tissue also. Further, the secondary walls of these foliar sclereids are thinner and unpitted, when compared to those of *Podocarpus*. The cauline sclereids are however fairly similar in both the genera, in distribution. But the secondary walls of the sclereids in *Dacrydium* sp. are thinner and the lumen of bark sclereids contains some substances, when compared to those of *Podocarpus*. These differences between closely related genera in the same family are rather interesting and may have a taxonomic significance.

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TIWARIASPORIS* GEN. NOV., A NEW SPORE GENUS FROM THE PERMIAN OF CONGO AND INDIA

HARI K. MAHESHWARI AND R. K. KAR

Birbal Sahni Institute of Palæobotany, Lucknow

STRIATE spores and pollen-grains form a significant part in most of the Permian assemblages. In the simplest form the striations are straight, $\pm$ parallel to each other, extending from one end to the other, mostly on the proximal face of the central body. In the complicated forms the striations are interconnected by vertical partitions and in some extreme cases the latter may dominate over the former.

Striate monolete and trilete spores are very rarely met with in the Palæozoic sediments though in the Mesozoic pseudo-striate trilete spores are very frequently found. The present paper deals with *Tiwariasporis,* a new spore genus possessing pseudo-striations recovered from the Permian sediments of Congo and India.

SYSTEMATIC PALYNOLOGY

Anteturma	..	*Sporites* H. Pot. 1893
Turma	..	*Monoletes* Ibrah. 1933
Subturma	..	*Azonomonoletes* Luber 1935
Infraturma	..	*Oranti* Pot. 1956
Genus	..	*Tiwariasporis* gen. nov.

TYPE SPECIES—*Tiwariasporis flavatus* GEN. *et* SP. NOV.

Generic Diagnosis.—Spores mostly oval-elliptical, sometimes with an incipient monolete mark. Exine thick, sculptured with closely placed and $\pm$ evenly distributed verrucæ-bacula on both surfaces, aligned in linear rows forming pseudo-striations in surface view. Rudimentary saccoid nature may be observed in some cases.

Generic Description.—The spores are mostly oval in overall shape with equally broad and rounded ends. Sometimes, however, elliptical forms are also found with equal or unequal ends. Monolete when present is ill-defined and hardly traceable in most cases. In most specimens it is not seen at all. The exine is upto 8 μ thick, densely sculptured with verrucæ,

sometimes interspersed with bacula and other elements. The sculptural elements are aligned in $\pm$ linear rows to form pseudo-striations in the inter-sculptural spaces. Both horizontal and vertical pseudo-striations are formed and in some specimens they may apparently look like a small, reticuloid grooves in the mud-crack-like pattern. Sometimes the sculptural elements along the outer margin may coalesce to form a small but uniform flange-like structure. Infrastructure of the exine may be present or absent; while present it seems to be infrapunctate in some, but in others it is not clearly discernible. In some specimens, incipient, saccoid lateral extensions of the exine are observed on both sides of the longer axis of the spore.

Comparison.—*Punctatasporites* Ibrahim (1933) is comparable to the present genus in its shape but is distinguished by its conid sculptural elements. *Thymospora* (Kosanke) Wilson and Venkatachala (1963) resembles the present genus in its sculptural elements; the former can, however, be readily differentiated by its strongly built verrucæ which are not very closely placed to align themselves to form pseudo-striations. *Lævigatosporites* Schopf, Wilson and Bentall (1944), *Latosporites* Potonié and Kremp (1954), and *Luenites* Bose and Kar (1966) are all psilate or punctate, monolete spores. *Striasporites* Bhardwaj (1955) is a true striate monolete spore genus and thus can be easily be separated. *Vittatina* (Luber) Wilson (1962) has been regarded by most of the authors as bisaccate pollen-grain and can be distinguished from *Tiwariasporis* by its differential ornamentational pattern on the two surfaces and regular distal ribs perpendicular to the proximal ones. *Costapollenites* Tschudy and Kosanke (1966) apparently resembles *Tiwariasporis* in its oval-elliptical shape, striations and rudimentary sacci. The striations in the

former genus are, however, of true nature and the pollen-grains are devoid of any marked sculpture.

Figs. 1-7. Figs. 1-2. *Tiwariasporis flavatus* gen. *et* sp. nov. (Holotype) proximal and distal views respectively, × 500. Figs. 3-4. *T. flavatus*, proximal and distal views of another specimen, × 500. Figs. 5-6. *T. simplex* (Tiwari) comb. nov, ×500. Fig. 7. *Tiwariasporis* sp. from Congo showing well developed sculptural elements and the pseudo-striations, × 500.

Remarks.—*Tiwariasporis* is singular among the monolete spores because its sculptural elements while compressed form pseudo-striations in surface view. In some cases, as has

been observed, they seem to be true striations due to more or less complete coalescence of the adjacent sculptural elements.

Many hypotheses have been put forward to explain the origin of the striations on the spores and pollen-grains. According to one view striations developed from *Illinites—Jugasporites—Limitisporites* complex by gradual straightening of the haptotypic mark to form finally a slit. According to another view these developed from the sculptural elements while compressed and coalesced together to form striations in the inter-sculptural spaces. The present genus shows such character which in due course may form true striations by complete coherence of the sculptural elements.

Tiwariasporis proposed here is regarded by the present authors as spore not for the occasional presence of monolete mark but for the well pronounced sculptural elements which extend to some extent on the rudimentary sacci also.

Tiwariasporis flavatus SP. Nov.
FIGS. 1-4

Holotype.—Figures 1, 2.

Type locality.—North Karanpura coalfield, India.

Specific Diagnosis.—Spores oval-elliptical, size range 62–68 μ. Monolete sometimes seen. Exine thick, mostly verrucose, verrucæ closely placed, ± evenly distributed in linear rows forming pseudo-striations, along the inter-sculptural spaces. Exine mostly infra-structured, comprising fine and uniformly distributed puncta.

Tiwariasporis gondwanensis (TIWARI) COMB. NOV.

Synonym.—*Welwitschiapites* *gondwanensis* Tiwari.

Holotype.—Tiwari, 1965, pl. 8, fig. 195.

Tiwariasporis simplex (TIWARI) COMB. NOV.
FIGS. 5, 6

Synonym.—*Welwitschiapites simplex* Tiwari.

Holotype.—Tiwari, 1965, pl. 9, fig. 200.

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* Named after Dr. R. S. Tiwari of the Sahni Irstitute, Lucknow, who first illustrated some specimens now referred to the new genus.

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LETTERS TO THE EDITOR

ABUNDANCE OF ISOTOPES OF LEAD IN A ROCK SAMPLE OF THE DECCAN TRAPS AND ESTIMATE OF THE AGE OF THE ROCK FROM THE LEAD-RATIO

A SAMPLE of rock from a quarry near Danda (Bandra), supplied by Dr. Sukheswala, Head of the Geology Department, St. Xavier's College, Bombay, was examined by spectro-chemical method by Khambata and Miranda,[1] and the total lead concentration in the rock was found to be 14 ± 1 ppm. This same sample was now examined for the abundance of the isotopes of lead.

The hyperfine structure of the lead line 4058 A.U. was obtained by using the Lummer-Gehrcke plate (Leiss-Berlin) of thickness $4 \cdot 125$ mm. in the parallel beam, crossed with a Forsterling three-prism train. The range without overlap of the Lummer plate pattern was obtained by photographing the Hg-line 4046, and was found to be $0 \cdot 158$ A.U. The pattern was measured with the Zeiss-Rapid Photometer.

Two parts of rock powder were mixed with one part of sodium carbonate added as a buffer to keep the temperature of the arc as uniform as possible. The electrodes were shaped from Ringsdorff carbons. Anode excitation was used. The electrode bore was 20 mm. deep, 5 mm. internal diameter and wall thickness of $0 \cdot 5$ mm. The counter electrode was pointed.

The arc was run at 35–40 volts and 8–9 amperes. Exposures of 60 to 200 minutes were required to photograph the 4058 line of Pb in the rock. With such long exposures, considerable interference from CN-band, with head at 4216 A.U. was to be expected. It was however found, that if the centre of the arc was focused on the slit and the exposure started after the bead was formed on the electrode, and the bead was maintained all along the exposure, there was no difficulty with the CN-band. The presence of sodium carbonate mixed with the rock powder, also helped to quench the CN emission.

The instrumental background was least with an exposure of 110 minutes on Ilford N 50-spectrum plate. The first visible order on the plate was the fourth from the centre.

The photographic response-relative intensity curve was constructed with Fe-lines, with relative intensities given by Ahrens and Taylor.[2] The hyperfine structure constants of the Pb-4058 line were taken as found by Rose and Granath[3] and the values of relative intensities of the spin components of 207 isotope, as obtained by Kopfermann and as quoted by Rose and Granath.

To correct the instrumental background effect, the following procedure was used. It was found that in the first two visible central orders the transmission between the fringes was nearly full, therefore there was little background effect. The ratio of the intensities of 208 to 206 in these orders was found to be $1 \cdot 17$. A correction graph was constructed so that the ratio of the intensities of 208 to 206 in the first seven visible orders was also $1 \cdot 17 \pm 0 \cdot 02$.

After correcting for the instrumental background in the fifth visible order, the fringe intensity distribution correction was made as follows. 19 reflections of 4046 Hg-line were observed at grazing emergence when the plate was adjusted. Hensen's value of effective number of reflections, therefore, was 12 and from the graph of the plate refractive index $1 \cdot 5$, the reflecting power was found to be $0 \cdot 76$.[4] From the fringe-intensity distribution curve thus obtained, the error due to the mutual contribution of the fringes was determined, and corrections were made as in the case of Fabry-Perot fringes.

Kopferman has found the relative intensities of the spin components of 207 of lead as predicted by theory, to be $5 : 1 : 9$. The component with the relative intensity nine, was found by him in the position of 208 when uranium-lead was examined. The only component of lead in the rock that could be measured was 207 (a) with relative intensity five. Since the relative intensity of 207 (a) to 208 was found to be $0 \cdot 012$ the total intensity of the components of 207 to 208 was $0 \cdot 036$. The relative intensities of $208 : 207 : 206$ was as $1 : 0 \cdot 036 : 0 \cdot 77$.

The age of the rock was estimated with the lead-ratio method. The ratio 207/206 was $0 \cdot 047$. From the graph the age of the rock was found to be $0 \cdot 9 \times 10^8$ years approximately. It must be remembered that the lead-ratio method is not accurate for young minerals and further no correction could be made for the primeval lead, as lead-204 was not detected.

It is a characteristic of common leads to have much higher proportions of lead-207 than are

found in radiogenic-leads,[5] and even a small amount of primeval lead would considerably increase the proportion of Pb-207 and hence the age of the rock.

Department of Physics,   S. J. KHAMBATA.
St. Xavier's College,   M. D. MIRANDA.
Bombay, *March* 27, 1967.   J. A. SALDANHA.

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ESTIMATION OF THE AVERAGE THERMAL EXPANSION OF HIGHLY ANISOTROPIC METALS FROM THE MORSE FUNCTION

MITRA AND JOSHI[1] have developed expressions for the evaluation of the thermal expansion of cubic metals on the basis of the Morse function. It is well known that certain metals having the hexagonal closed-packed structure, particularly those with $c/a \approx 1.63$ show very little anisotropy in their physical properties. It was therefore felt by the author[2] that it would be possible to estimate the average thermal expansion of *hcp* metals by using the procedure adopted by Mitra and Joshi. The agreement between the calculated and experimental values turned out to be quite good. It was surprising to observe that the agreement was good even for metals having c/a different from 1.63, *i.e.*, metals like Zn and Cd which show considerable anisotropy. This suggests that for purposes of estimating the average physical properties of anisotropic crystals the assumption of a spherically symmetric potential function is not a serious drawback. To test this point further we have extended the calculations to tellurium and selenium. These metals have an exceedingly high degree of anisotropy as can be seen from the values of the principal expansion coefficients given in Table I. As in the earlier work[2] the

TABLE I

Experimental* and calculated values of the thermal expansion coefficients $(\times 10^6)$

Metal	α_a	α_c	α_{av} (expt.)	α_{av} (calc.)
Te	35·3	−2·53	22·7	29·6
Se	72·5	−6·7	46·1	50·1

fs. 4 and 5.

data needed for the calculations are taken from the recent compilation by Gschneidner.[3] The calculated values are given in Table I. In view of the approximations involved in the treatment, the agreement between calculated and experimental values may be considered fair, particularly for Se.

Physics Department,   D. B. SIRDESHMUKH.
Osmania University,
Hyderabad-7, *January* 19, 1967.

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FRANCK-CONDON FACTORS AND r -CENTROIDS OF THE NEW $^2\Sigma^+ - X^2\Sigma^+$ BAND SYSTEM OF AlO

BAND spectra due to aluminium oxide are known to appear in stellar sources and a knowledge of relative intensities of the bands is of astrophysical importance. Calculations of vibrational intensity distributions for different band systems of AlO have been reported earlier.[1,2] Recently a new band system of this molecule has been recorded in the ultra-violet region of the spectrum.[3] The present note gives the calculated Franck-Condon factors and r-centroids for this band system.

The method of *a*-averaging suggested by Fraser and Jarmain[4] along with the computational procedure described by Sankaranarayanan[5] was employed for the evaluation of the Franck-Condon factors. Since for this system $|\delta a/a| \approx 10\%$ the 'r_e-shift' correction[6] was adopted to improve the results. The r-centroids were calculated by the graphical method due to Nicholls and Jarmain.[7] The results are shown in Table I. The calculated Franck-Condon factors are in reasonable agreement with the estimated visual intensities. [*e.g.*, the bands (1, 1), (0, 4) and (4, 0) have small Franck-Condon factors and are not observed]. The r-centroids show the expected increase with increase in wavelength. The rate of increase in a sequence is quite small and is probably due to the near parabolic character of the potential energy curves for low vibrational quantum numbers in both states.

TABLE I

v' \\ v''	0	1	2	3	4	5	6	7
0	0·419	0·614	0·368	0·019	0·019	..	..	..
	0·369	0·572	0·364	0·115	0·021	..	..	..
	1·668	1·671	1·676	1·680	–	..	..	..
	(2487)	(2548)	(2611)	(2677)	(–)	..	..	..
1	0·477	0·043	0·145	·.	..	..	..	..
	0·513	0·008	0·184	..	..	..	..	..
	1·665	1·668	1·672	1·677	1·680	..	..	..
	(2438)	(–)	(2557)	(2620)	(2685)	..	..	..
2	0·328	0·080	..	..	..	..	..	..
	0·307	0·052	..	..	..	..	..	..
	1·662	1·665	..	..	1·677	1·681	1·684	..
	(2391)	(–)	..	..	(2629)	(2693)	(2760)	..
3	0·179	0·203	..	..	..	..	..	..
	0·201	0·175	..	..	..	..	..	..
	1·659	1·662	..	..	..	..	1·681	1·684
	(2347)	(–)	..	..	..	..	(2701)	(2767)
4	0·096	..	..	..	..	..	..	..
	0·095	..	..	..	..	..	..	..
	–	..	..	..	..	..	..	..
	(–)	..	..	..	..	..	..	..

First row : F.C. factors without 'r_e-shift' correction ;   Second row : F.C. factors with 'r_e-shift' correction; Third row : r-centroids ;   Fourth row : Wavelength of corresponding bands.

Dept. of Spectroscopy,   (MISS) D. V. A. RAO.
Banaras Hindu Univ.,   K. P. R. NAIR.
Varanasi-5,   D. K. RAI.
April 27, 1967.

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CYCLISATION OF SUBSTITUTED CINNAMAMIDES ; FORMATION OF SOME NEW CARBOSTYRILS

SEVERAL methods are available for the cyclisation of substituted cinnamamides. Mayer *et al.*[1] cyclised 3-halo-propionanilides using aluminium chloride in order to prepare the corresponding carbostyrils. Conley and Knopka[2] cyclised a series of N-(4-substituted)-phenylcinnamamides using polyphosphoric acid and obtained several 3, 4-dihydro-4-phenyl-6-substituted carbostyrils.

In the course of our study of the condensation of certain malonic acid derivatives with aromatic aldehydes we have obtained a large number of N-phenyl-cinnamamides with substituents in both aromatic rings. Cyclisation of these cinnamamides would not only give new carbostyrils which may have pharmacological activity but also throw some light on the influence of substituent groups on the course of the reaction. With these objects in view some experiments have been carried out and the results are presented in this note.

The cinnamamides chosen are *o*- and *p*-methoxy, *o*- and *p*-chloro, *m*-nitro, *m*- and *p*-hydroxy-cinnamanilides and cinnam-*o*, and *p*-toluidides. The general procedure has been to heat the cinnamamides in presence of excess of polyphosphoric acid at 120° for 30 min. After cooling, the mixture was poured over crushed ice and then extracted with chloroform. Removal of the solvent and recrystallisation of the residue from aqueous ethanol gave the carbostyril in white crystals. The yields, m.p. and analytical results are given in Table I.

It is however noteworthy that *p*-hydroxy cinnamanilide and cinnam-*o*-toluidide did not cyclise under the above conditions.

TABLE I

No.	Name of the amide	Name of the carbostyrils	Yield %	M.P. °C.	Nitrogen Found
1	*o*-Methoxy-R	R_1-(*o*-methoxy-phenyl)-R_2	30	118	5·31
2	*p*-Methoxy-R	R_1-(*p*-methoxy-phenyl)-R_2	25	190	5·27
3	*o*-Chloro-R	R_1-(*o*-chloro-phenyl)-R_2	25	153	5·45
4	*p*-Chloro R	R_1-(*p*-chloro-phenyl)-R_2	40	140	5·21
5	*m*-Nitro-R	R_1-(*m*-nitro-phenyl)-R_2	40	199	10·39
6	*m*-Hydroxy-R	R_1-(*m*-hydroxy-phenyl)R_2	20	161	5·75
7	Cinnam-*m*-toluidide	3 : 4-dihydro (7-methyl-4-phenyl)R_2	25	188	5·31

R = Cinnamanilides ; R_1 = 3 : 4-Dihydro-4-; R_2 = Carbostyril.

The structure of the new carbostyrils was confirmed by physical methods also. The characteristics reported by Conley and Knopka (*loc. cit.*) in the I.R. spectra of these compounds have been observed by us also, namely, the absence of the α-β-unsaturated linkage in conjugation with the amide carbonyl and the amide II linkage of secondary amides which is generally absent in lactams. Other characteristics are the band at 1670 cm.$^{-1}$ typical of a carbonyl stretching (amide I band) and the band at 3260 cm.$^{-1}$ typical of –NH– stretching (cyclic amides).

We are grateful to the Ministry of Education, Government of India, for a Research Training Scholarship to one of us (O. P. S.).

Dept. of Chemistry,   O. P. SINGHAL.
St. John's College,   P. I. ITTYERAH.
Agra, *March* 11, 1967.

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PHASE STUDIES IN THE SYSTEM: ZrO_2-TiO_2

SEVERAL workers[1-3] have studied ZrO_2-TiO_2 system and reported partial solid solution between the composite oxides. Brown and Duwez[4] have reported only one compound in this system. Results of some detailed studies on this mixed metal oxides system are reported here.

Equimolecular proportion of zirconia and titania were mixed together and fired at 1400° C. for 20 hr. in a muffle furnance in air. The product was cooled, powdered and examined by X-ray powder techniques.

In the present study, a Guinier type focussing camera was used to have a better resolution of low angle lines.

The Guinier photograph of the product showed two phases—monoclinic zirconia solid solution and $ZrTiO_4$. The product was, there-fore, refired at 1660° C. for 10 hr. in air, then analysed by X-rays as before. The powder photograph now showed only one phase $ZrTiO_4$. It was indexed on the basis of orthorhombic unit cell with the following lattice constant

$$a = 4·800, \quad b = 5·008, \quad c = 5·451 \text{Å}.$$

There was no evidence of any other compound in the system.

Department of Chemistry,   V. V. DESHPANDE.
College of Science,   K. RAMA RAO.
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PAPER CHROMATOGRAPHIC SEPARATION OF SOME HETEROCYCLIC AMINES

THE paper chromatographic separation of some individual heterocyclic compounds containing nitrogen(s) as hetero atom(s) is reported in the literature but so far no effort has been made to separate and identify benzimidazole, acridine and quinoline-amines either present together or separately. The present communication deals with identification of such 18 amino-derivatives of benzimidazole, acridine and quinoline (as hydrochloride or as oxalate) by paper chromatography using different solvent systems. It is interesting to note that these amine salts cause no interference with colour development and with their R_f values. The

observations regarding R_f values and other relevant data are recorded in Table I.

$5-30\gamma$ in all cases on paper (Whatman No. 1) and it was equilibrated for 30 minutes in the

TABLE I

Amino derivatives	R_f				Colour	
	S_1	S_2	S_3	S_4	U. V. Light	Visible light
1. 4 (2-Dimethylaminoethylamino) quinoline oxalate	0·45	0·52	..	..	..	Orange
2. 4-2 (1-piperidine) ethylamino quinoline dioxalate	0·65	0·74	..	..	..	,,
3. 4-2 (1-pyrrolidine) ethylamino quinoline dioxalate	0·52	0·63	..	..	..	,,
4. 4-2 (4-morpholine) ethylamino quinoline dioxalate	0·50	0·56	..	..	..	,,
5. 4-(2-N-methyl, N-phenylaminoethylamino) quinoline	0·96	0·84	..	..	..	,,
6. 4 (2-o-toludine-ethylamino) quinoline	0·96	0·89	..	..	..	,,
7. 4 (2-N-ethyl, N-phenylaminoethylamino) quinoline	0·92	0·65	..	..	..	,,
8. 4 (2-diethylaminoethylamino) quinoline	0·58	0·69	..	..	..	,,
9. 9 (2-diethylaminoethylamino) acridine dihydro-chloride	0·61	.	..	0·90	Blue	Yellowish-green
10. 9 (2-dimethylaminoethyl amino) acridine dihydro-chloride	0·77	..	..	0·93	,,	,,
11. 9-2 (1-pyrrolidine) ethylaminoacridine hydrochloride	0·78	..	..	0·95	,,	,,
12. 9-2 (4-morpholine) ethylaminoacridine hydrochloride	0·76	..	..	0·88	,,	,,
13. 9-Chloroacridine	0·95	..	..	0·95	,,	,,
14. 2-2 (4-morpholine) ethylaminobenzimidazole oxalate	..	..	0·96	..	..	Orange
15. 2-2 N-methyl, N-phenylamino ethyl benzimidazole oxalate	...	..	0·96	..	..	Light orange
16. 2-2-o-toluidinoethylaminobenzimidazole oxalate	..	..	0·93	..	..	Yellowish
17. 2-2-m-toluidinoethylaminobenzimidazole oxalate	..	..	0·75	..	..	Deep yellow
18. 2-2-N-ethyl-N-phenylaminoethylaminobenzimidazole	..	..	0·78	..	..	Yellowish-orange

$S_1 = n$-Butanol, acetic acid, water (40 : 10 : 50), layer rejected, $S_3 =$ Dioxane, water (100 : 4·2), 50 ml. water. $S_2 = n$-Butanol, 3-N-HCl (150 : 150) lower aqueous $S_4 = n$-Propanol, dil. HCl (20 : 30), 5 ml. 13 N-HCl in

Diazo[1] reagent spray was used with enough success for the development of benzimidazole amines which produced orange to yellow spots. For quinoline and acridine-amines Dragendorff's[2] reagent was found well suited which produced respectively deep orange and yellowish-orange spots. The arcidine amines were, however, visible as greenish-yellow spots $(1-20\gamma)$ on paper and therefore they could be identified even without the help of Dragendorff's reagent.

Out of many solvent systems attempted the following four only could give desired separation :

1. n-Butanol, acetic acid, water (40 : 10 : 50).
2. n-Propanol, dil. HCl (20 : 30). Dil. HCl prepared by mixing 5 ml. of 13 N-HCl in 50 ml. of distilled water.
3. Dioxane, water (100 : 4·2).
4. n-Butanol saturated with 3 N-HCl (150 ml. each)—lower aqueous layer was rejected.

The solvent system (1) was found suitable to bring about separation of quinoline and acridine-amines, present together or separately. The compounds were applied in the range of

atmosphere of the solvent prior to irrigation. The runs were made in ascending direction at room temperature (23° C.) for 10–12 hours and in all the cases results were reproducible within an R limit of $\pm 0·03$.

In conclusion it may be pointed out that quinoline amines individually or as mixtures with acridine amines can be separated and identified using solvent system, S_1 (*vide* Table I).

Thanks are due to Prof. G. B. Singh for providing the necessary facilities and to Mr. Kanwal Nain for kindly supplying the compounds which were prepared by him in this laboratory.

Dept. of Chemistry,   S. M. DESHPANDE.
Organic Chem. Division,   R. R. UPADHYAY.
Banaras Hindu University,
Varanasi-5 (India), *April 18, 1967.*

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CHEMICAL COMPOSITION OF SOME WILD INDIAN LEGUMINOUS SEEDS

WITH a view to explore newer and effective sources of proteins some wild uncultivated leguminous seeds of plants which grow profusely in the country have been studied and the results are reported here.

Seeds of *Bauhinia purpurea, Cassia glauca,* the red and yellow-flowered varieties of *Delonix regia, Pongamia glabra, Prosopis juliflora* and *Sesbania grandiflora* were subjected to a preliminary analysis with respect to ash, moisture, fat (ether extractives) and total crude protein. Since carbohydrates happen to be the chief source of energy in animal nutrition and get most rapidly utilized, it was thought interesting to make a study thereof and compare the results with those of our previous investigation[1] on some other wild leguminous seeds.

All the leguminous seeds were collected locally from the Alfred Park, Botanical Garden of Allahabad University and the Government

was employed for the quantitative estimation of carbohydrates. Estimations were made by following the method of Trevelyan and Harrison.[3]

For the qualitative analysis of free sugars in the seeds, 80% ethanolic extracts of the defatted seed meals were prepared as described by Williams *et al.*[4] employing the paper partition chromatographic technique of Consden *et al.*[5] using Partridge's method.[6] The below-mentioned solvent systems were employed. The proportions of the components of the solvent systems are by volumes.

    I.   Iso-propanol-Butan-1-ol-water   (140 : 20 : 40).

   II.   Pyridine-isoamylol-water   (80 : 40 : 70).

  III.   Butan-1-ol-ethanol-water-ammonia (45 : 5 : 49 : 1).

  IV.   Butan-1-ol-acetic acid-water (40 : 10 : 50).

Table I represents the results of the preliminary analysis.

TABLE I

Chemical composition of some wild Indian leguminous seeds

(Results represented on dry weight basis)

Leguminous seed	Moisture %	Fat % (ether extractive)	Ash %	Crude protein in whole seed meal (N × 6·25)	Crude protein in defatted seed meal (N × 6·25)	Total soluble carbohydrate% in terms of glucose
Bauhinia purpurea	7·00	16·58	3·80	27·31	35·31	15·40
Cassia glauca	6·65	7·78	4·07	18·75	20·81	24·37
Delonix regia (yellow flowered)	5·80	6·05	4·70	27·75	28·00	13·80
Delonix regia (red flowered)	6·04	5·03	3·80	22·18	25·00	17·50
Pongamia glabra	5·50	37·50	3·00	19·62	32·62	32·30
Prosopis juliflora	10·94	4·50	3·80	39·25	41·75	18·00
Sesbania grandiflora	6·25	7·36	4·50	33·37	38·50	17·50

House Garden. After cleaning, the well-dried seeds were powdered in an electrical grinder to 100 mesh, defatted with petroleum ether (60–80°) and preserved in dry airtight bottles.

Moisture, ash and fat contents were determined according to the A.O.A.C. methods.[2] Nitrogen was determined by the micro-Kjeldahl method and from the results obtained, percentage of crude protein was calculated.

For the estimation of total carbohydrates, extracts of defatted seed meals (200–500 mg.) were made in aqueous saturated solution of benzoic acid at 100°. The residue was re-extracted several times till the filtrate was negative to Molische's test. The combined extract diluted to a known volume (100 ml.)

Reference to Table I shows that all the seeds examined contain appreciably high percentage of proteins (18–39). Higher percentage of protein (20–41) in the defatted meals suggests the presence of a small proportion of lipoproteins in the seed proteins. The fat content of all the seeds although quite comparable with one another, in the seeds of *Bauhinia purpurea* and *Pongamia glabra* (particularly in the latter) it is noticeably high. In line with the protein content, the percentage of the energy providing carbohydrates also appears to be quite high and although the values are comparable with one another, the seeds of *Pongamia glabra* and *Cassia glauca* seem to contain higher percentage of total soluble carbohydrates;

Qualitative analysis of the seed powders for free soluble sugars shows the presence of sucrose and raffinose in all the seeds except in those of *Bauhinia purpurea* which depicts the presence of sucrose and glucose.

Biochemistry Section,   RADHA PANT.
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DISPERSION EFFECTS IN COPRECIPITATED NICKEL CATALYSTS

THERE have been several reports recently trying to correlate the catalytic activities and chemistorption properties of nickel dispersed in various supports. In one of them, Sinfelt[1] reported a magnetic study of nickel dispersed in silica and silica-alumina. In this preliminary communication, we wish to report a comparison of the chemisorption activities of three nickel catalysts of varying dispersion in magnesia.

The preparation of the catalysts and the experimental techniques employed have been described elsewhere.[2] Relevant significant information is included in Table I. Only the low temperature adsorption data are given in Table I since the fast adsorption activities of nickel catalysts have been well established and better understood at low temperatures by the study of isotherms. The data on activated adsorption on these catalysts will be discussed in detail in a later communication. In line with the method adopted by Sinfelt,[1] equilibrium values of hydrogen adsorbed after 30 min. are reported in Table I.

Examination of the data in Table I shows that on the basis of specific adsorption, catalyst IV is the most, and catalyst V, the least active of the three studied. Catalyst I, in spite of its high nickel content has a lower activity than catalyst IV indicating that it has a lower amount of surface nickel than catalyst IV. This difference may well be due to the longer period

TABLE I

	Weight g.	Nickel content	Reduction (a)
Catalyst I ..	4·5094	26·56 %	1·2054 g.	24 hours
,, IV ..	3·9998	14·56 %	0·5068 g.	72 ,,
,, V ..	7·2935	8·564 %	0·5798 g.	60 ,,

Adsorption data (b)

Equilibrium press of hydrogen in cm.	Catalyst I	Catalyst IV	Catalyst V
10	6·042	4·804	0·284
5	5·943	4·762	0·269
1	5·893	4·761	0·262

Specific adsorption activity (c)

10	5·014	9·477	0·490
5	4·930	9·396	0·464
1	4·888	9·394	0·417

(a) Reduction time in hours, temperature $475 \pm 5°$ C.
(b) Hydrogen adsorbed in ml. NTP, at $-183°$ C.
(c) Specific adsorption activity calculated per gm. of nickel.

of reduction, 72 hrs., compared with the 24 hrs. in the case of catalyst I. It has been recognised that the times of reduction play a major role in breaking aggregates of nickel oxide even in the interior of the crystal lattice of the support material, bringing up more metallic nickel to the surface. The occurrence of this phenomenon with volume decrease as revealed by electron optical studies, has been reported earlier from this laboratory[3] and also by Yamaguchi.[4]

The lowest activity of catalyst V seems to be due to the MgO lattice itself in which the nickel atoms are so embedded as to be inaccessible for hydrogen chemisorption. A longer period of reduction, say of 72 instead of 60 hrs. could not have raised its specific adsorption from 0·490 to the 9·447 of catalyst IV, when even 24 hrs. reduction results in a specific activity of 5·014 for catalyst I. This markedly low adsorption activity of catalyst V must be due to the nature of dispersion of nickel in MgO in this case. Nickel atoms of this type have been proposed by Schuit and de Boer[5] in the case of nickel-silica system and by Selwood[6] in the case of nickel-magnesia.

We have no data at present on the crystallite size of nickel dispersed in magnesia for a fuller explanation of our results. Work for getting such data and on the catalytic activity of these catalysts is in progress. Catalytic activity along with chemisorption data might throw light on the exact nature of nickel catalysts and on the geometric factor in relation to the hydrogenation and other reactions catalysed by them.[7] It may be of interest to note that the lattice-metal interaction of recent interest[8,9] should be

negligible in nickel-magnesia catalysts since MgO behaves as a typical insulator in the temperature range studied.[10]

One of us (NSV) thanks the Council of Scientific and Industrial Research, New Delhi, for a Fellowship in the Research Unit "Chemisorption and Catalysis" in the Chemistry Department, Loyola College.

Dept. of Chemistry,   N. S. VISWANATHAN.*
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A NEW BROMOLACTONE OF OLEANOLIC ACID

EARLIER workers have studied the bromination of oleanolic acid and its different reaction products.[1] Several workers studied the bromination reaction of compounds of α- and β-amyrene series.[2,3] Bromolactone of oleanolic acid, m.p. 243°, prepared by treatment of oleanolic acid with bromine in acetic acid is well known.[4] But no spectral data appears to exist in literature. This lactone was prepared for the present study by following the method of Heywood et al.,[5] and infra-red spectra was noted. Infra-red absorption spectral analysis of the lactone showed peak absorption at 1355 cm.$^{-1}$, 1385 cm.$^{-1}$ (*gem*-dimethyl), 1705 cm.$^{-1}$ (axial bromine), 1775 cm.$^{-1}$ (γ-lactone), 3450 cm.$^{-1}$ (hydroxyl).

In course of preparation of the bromolactone of oleanolic acid another isomeric bromolactone of oleanolic acid, m.p. 212°, was observed depending on the solvent used.

1 gm. of oleanolic acid dissolved in 100 ml. of chloroform was treated with 5% bromine in chloroform until saturated. This was kept at room temperature for three hours after which both bromine and chloroform were removed

under vacuum. The solid residue was taken up in ether and washed with 2% sodium hydroxide solution to remove any free acid left. Then the ether was washed free from alkali with distilled water, and dried with anhydrous sodium sulphate. The ether was distilled off and the bromolactone was repeatedly crystallised from methyl alcohol in fine needles, m.p. 212°. This bromolactone showed the presence of halogen and absence of unsaturation towards tetranitromethan. The bromolactone, m.p. 212°, showed depression in m.m.p. determination with the bromolactone, m.p. 243°. Both the bromolactone when treated with zinc and acetic acid furnished an acid that was converted to the corresponding methyl ester with diazomethane. Both the esters were identified to be methyl oleanolate, m.p. 198–200°.

OLEANOLIC ACID   Br/CH₃ COOH   γ– LACTONE M.P. 243°

Br/CHCl₃   δ– LACTONE M.P. 212°

Infra-red absorption spectral analysis of the bromolactone, m.p. 212°, showed identical peak absorption with the previous one with the only exception of a peak at 1758 cm.$^{-1}$ (δ-lactone) and absence of a peak at 1705 cm.$^{-1}$ (absence of axial bromine). It is probable that the 6-membered δ-lactone has been formed with the axial bromine atom at C_{12} position.

Chemical Unit,   A. K. DAS.
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OCCURRENCE OF FOSSIL DECAPOD CRUSTACEA IN EOCENE DEPOSITS OF ASSAM*

THE junior author in course of field work during 1965-66 in parts of North Cachar and Mikir Hills District, Assam, collected two fragments of fossil decapod crustacea from the Sylhet Limestones exposed 3 km. south of Garampani (25° 30' 45" : 92° 37' 30"). The fossils come from argillaceous limestone at the topmost horizon of the Sylhet stage. The argillaceous limestone contains the larger foraminifer *Nummulites beaumonti* in abundance together with *Echinolampas* cf. *discoideus,* *Terebellum, Conus, Turritella, Natica* and *Cardium.* The presence of *Nummulites beaumonti* indicates a Kirthar age (Middle Eocene) to the bed. The fossils were studied at the Central Palæontological Laboratory, Geological Survey of India, Calcutta.

One of the specimens in the present collection consists of a left manus of a burrowing shrimp and is referable to *Callianassa* Leach. The other specimen is a right manus belonging to a crab and is tentatively assigned to ? *Galenopsis* Milne-Edwards.

Callianassa SP.

This is the first record of fossil decapod crustacea from Assam although its occurrence is known from the neighbouring State of Burma since 1895.[1] The genus *Callianassa* Leach was first noted by Noetling[1,2] from the Lower Miocene formations of Burma. Some fragments of chelæ, grouped under *Uca/Cardiosoma* by Stoliczka[3] from the Lower Miocene of Kutch may also belong to this genus. So far, there is no record of this genus from the Eocene formations of India and the neighbouring countries. As such the present record is of special importance. *Callianassa* is abundantly found in the Lower Tertiary formations throughout the world. Complete specimens of *Callianassa* are rarely found and it is mostly on the basis of the chelæ portion that the majority of the species are established.

In the present specimen (G.S.I. Type No. 18317; Figs. 1 and 1 *a*) the manus is square in shape; the height and length are approximately 21 mm. The external side is tumid whereas the internal side is more or less flat. The lower edge of the manus contains a series of small spines; the serration on the upper edge are comparatively very few. On the external side minute punctuations are present which are confined only to the lower one-third portion of the manus, the rest being smooth. Near the proximal end, a few small closely placed granules are present. The internal side has small but prominent tubercles at the proximal lower edge. Neither the movable nor the immovable finger is available for study.

The specimen from Assam resembles the Burmese species *Callianassa birmanica* Noetling in being squarish in shape and having no pores on either of the edges. But it differs from the same in being smaller in size, having less prominent tubercles on both external as well as internal sides and presence of minute punctuations on the external side; serrations on the lower edge are also less in the Indian form.

? *Galenopsis* SP.

It is with certain degree of reservation that the other specimen (G.S.I. Type No. 18318; Figs. 2 and 2 *a*) has been assigned to the genus

FIGS. 1, 1 *a. Callianassa* sp. (left manus), × 1·5;
Fig. 1. External view, and Fig. 1*a*. Internal view.
FIGS, 2, 2 *a. Galenopsis* sp. (right manus), ×1·5;
Fig. 2. External view and Fig. 2 *a.* Internal view.

Galenopsis Milne-Edwards. The single specimen consisting of the right manus does not seem to belong to any of the known species of *Galenopsis* from India. In the present specimen, the manus is longer (32 mm.) than high (22 mm.). Both the upper and the lower margins are rounded,

smooth and tapering proximally. The manus is medially raised both on the external and internal sides. On the internal side it assumes the shape of a ridge. On the external side, the manus is somewhat depressed at the lower distal end. A few pores arranged in a row can be made out on the lower edge of the immovable finger. Two cutting teeth are seen in the available length of the immovable finger which is highly compressed.

The specimens are deposited in the Geological Survey of India type collection.

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Central Palæontological   U. B. MATHUR.
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Engineering Geology
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* Published with the kind permission of the Director-General, Geological Survey of India.
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PALYNOLOGICAL DATING OF THE VARIEGATED STAGE OF SALT RANGE (WEST PAKISTAN)

IN a paper published in 1955, one[1] of us recorded for the first time a palynological assemblage from a carbonaceous shale within the Variegated Stage of Nammal Gorge Section in the Salt Range. From the spore-pollen evidence a Middle Jurassic age was ascribed to these beds. The geologists assigned a Lower-Middle Jurassic age for the Variegated Stage.

The object of this note is to record the conclusions arrived at, concerning the relative age of the basal members of the Variegated Stage of the Nammal Gorge Section of the Salt Range.

Two papers—one dealing with the megaspores and the other dealing with the misopores—are under publication. These are based on the reinvestigations of the type material (Sah, *l.c.*). The palynological fossils recorded and described in these two papers can be summarised as follows :

(*i*) *Megaspores*
  Nathorstisporites hopliticus Jung
  Nathorstisporites reticulatus Dettmann
  Nathorstisporites peltasticus Jung
  Nathorstisporites nammalensis Sah and Jain

Banksisporites sinuous Dettmann
Hughesisporites novus Sah and Jain
Minerisporites sp.

(*ii*) *Miospores*
  Todisporites, Staplinisporites, Tigrisporites, Ischyosporites, Divisisporites, Baculatisporites, Osmundacidites, Spongiosisporites, Cosmosporites, Classopollis, Dictyophyllidites, Gliscopollis Perinopollenites, Matonisporites, Eucommiidites trodssonii, Lycopodiumsporites, Spheripollenites, Cycadopites, Podocarpidites and *Araucariacites.*

From the megaspore evidence it appears that the present Salt Range assemblage might be biostratigraphically equivalent to the Leigh Creek Coal Measures bed of South Australia,[2] *i.e.*, Rhætic-Liassic.

The miospore assemblage, especially the presence or absence of certain important genera and species, whose distribution in time and space is well recognised within the Mesozoic, indicates that the variegated beds could not be younger or older than the Lower Jurassic. For instance, the absence of genera like *Ovalipollis, Aratrisporites, Aulisporites, Accinctisporites, Anapiculatisporites, Lundbladispora* and striated saccate pollen-grains from the Salt Range assemblage precludes a Upper Triassic age for the beds. Similarly the absence of genera, *viz.*, *Trilobosporites, Cicatricosisporites* and *Contignisporites,* etc., restrict the age of the beds to the Liassic. Finally the characteristics of the Salt Range assemblage especially, the abundance of *Classopollis, Gliscopollis, Spheripollenites, Perinopollenites* together with a good percentage of *Matonisporites, Staplinisporites, Ischyosporites* and *Tigrisporites* also favour a Liassic age for the beds.

It is therefore evident that the present palynological assemblage from Nammal Gorge, Salt Range, suggests a Lower Jurassic (Liassic) age for the variegated shale rather than a Middle Jurassic age as postulated earlier. The sample yielding a palynological assemblage comes from the lower horizons of the Variegated Stage and since we have not been able to recover any palynological data from the upper horizons of the Stage, it is quite likely that a part of the Variegated Stage might have been deposited during the Middle Jurassic times.

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PHILOPHTHALMUS SP. (TREMATODA: PHILOPHTHALMIDAE) FROM THE EYE OF VULTURE IN INDIA

WHILE studying the growth of *Philophthalmus* sp. on chorioallantois of chick embryos, Fried[1] observed an interesting phenomenon of absence of vitellaria on the left side of one of the reared philophthalmids. In the course of investigations on the ocular trematode parasites, the same unusual character of one-sided vitellaria was observed in a single specimen collected from the orbital cavity of the vulture, *Neophron percnopterus* (Linnaeus) in India. As it shows some interesting characters along with the one mentioned above, and as this is a natural infection, it was felt desirable to make a record of it.

Philophthalmus SP.

The fluke measures 6·48 by 2·03 mm. and has attenuated anterior and rounded posterior ends. The general body surface is smooth. The two suckers are unequal, oral measuring 0·35 by 0·51 mm. and ventral 0·63 by 0·63 mm., the latter situated in the anterior third of the body. The subterminal mouth leads into a muscular pharynx, 0·35 by 0·42 mm. The oesophagus measures 0·21 by 0·25 mm. The cæca are tubular and extend beyond the posterior testis in the caudal region.

FIG. 1. *Philophthalmus* sp. (ventral view).

The testes are diagonal, equal and occupy the posterior third of the body, measure 0·94 by 1·12 mm. Two vasa efferentia meet each other just above the equator and the vasa deferens to seminal vesicle at the posterior margin of the ventral sucker. The cirrus sac measures 1·26 mm. in length, encloses seminal vesicle, 0·70 mm., a small pars prostatica and a muscular cirrus, 0·40 mm. The genital pore is median and mid-oesophageal.

The ovary compared with the testes is very small, just anterior to the anterior testis, measures 0·24 by 0·26 mm. Receptaculum seminis uterinum is present. Shell gland cells and ootype are covered by the anterior testis. The uterus is horizontally coiled, packed with eggs, 81 to 91 μ by 32 to 37 μ containing miracidia with eye-spots.

The most unusual structure, as observed by Fried in one of the reared flukes, is the vitelline follicles which are present only on the right side. There are five definite bundles of vitellaria, the first and the last being tubular and the middle three follicular. These start a little in front of the equator and extend up to the middle of the anterior testis.

The excretory pore is terminal, the vesicle is well developed and the arms stretch up to the oral sucker.

Host   : *Neophron percnopterus* (Linnaeus .
Habitat   : Orbital cavity.
Locality : Aurangabad, Maharashtra, India.
Specimen : Holotype in the author's collection.

As only one specimen is collected it is felt desirable to record it as *Philophthalmus* sp. till some more flukes are collected and observed.

Sincere thanks are due to Dr. Syed Mehdi Ali for guidance in the course of study.

Department of Zoology,   P. P. KARYAKARTE.
Marathwada University,
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INFLUENCE OF ENVIRONMENT ON THE DIGESTIVE ENZYMES OF A FISH, *TILAPIA MOSSAMBICA* (PETERS)

DESPITE observations on the digestive enzymes in relation to food of fishes[1-5] little attention appears to have been paid to the adaptive changes involved in these enzymes in any one fish species thriving in two or more completely different habitats. The present communication relates to preliminary observations on the food

and digestive enzymes of *Tilapia mossambica* (Peters), an exotic fish in Indian freshwaters. Comparisons are based on the food habits in relation to digestive enzymes observed in the course of the present investigations and those reported from their natural environment.[6]

100 specimens of different age-groups of *Tilapia* were procured locally from a fresh-water fish-farm for routine examination of gut contents and analyses of digestive enzymes during the period August 1965 to April 1966. Lipase, invertase, amylase, proteinase and peptidase were detected (Table I) in the different regions of the alimentary canal by standard methods.[7]

TABLE I

Enzymatic activity in the different regions of the alimentary canal of Tilapia mossambica *(Peters)*

	Lipase	Invertase	Amylase	Proteinase	Peptidase
Buccal cavity	p	rp	p(a)	a	a
Stomach	p	p	pp	pp	pp
Intestine	ppp	ppp	ppp	ppp	pp

a : absent ;   p : weak ;   pp : present ;   ppp : strong.

In the natural environment *Tilapia* has been reported[6] to have a dietary consisting of algæ, diatoms, zooplankton, aquatic phanerogams, photosynthetic bacteria and organic deposits, and secretes only two digestive enzymes, viz., amylase and proteinase. Considering the presence of zooplankton, however, in the dietary *Tilapia* should have been more appropriately categorised as omnivorous.[8]

The present studies have revealed not only differences in food habits but also variations in the nature and relative strength of the digestive enzymes consequent to change in environmental conditions. *Tilapia* in the freshwaters of Kalyani have been observed to feed on fresh-water algæ, diatoms and aquatic plants and is herbivorous, confirming that a change in environment involves a change in food habit.[9]

Amylase has been reported[6] from the buccal cavity of *Tilapia* from its natural habitat while we have been able to identify invertase in addition to a weak amylase. While confirming the presence of amylase, proteinase and pepti-dase we have also determined the presence of lipase in the stomach of *Tilapia*. The presence of amylase in the intestine reported earlier[6] has been confirmed while lipolytic activity is being reported here for the first time.

The main production of invertase occurs in the intestine of the fish[10] although there appears to be no existing record of it from *Tilapia*. We have found invertase to be strongly positive in this region.

A greater activity of protease in acid media in the stomach of *Tilapia* than the rest of the gut has been reported[6] but it has been emphasised that there is little evidence of any activity in the extracts from the rest of the gut. A strong proteinase and a relatively weaker peptidase have also been detected.

The data presented here indicate that the nature and the relative activity of the digestive enzymes in a fish may be correlated with its dietary and is subject to adaptation as a result of change in food habits consequent to introduction into a completely different environment. It may also be possible that a fish may have the potentiality to secrete a particular enzyme but its activity depends on the presence or absence of the specific food in its dietary.

Fisheries Laboratory,   S. K. MOITRA.
Department of Zoology,   K. M. DAS.
Faculty of Science,
University of Kalyani,
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EFFECT OF PHOTOPERIOD ON PANICLE EMERGENCE IN RICE

IT is normally observed that the duration from panicle initiation to complete emergence is about thirty days in most of the cultivated rice varieties and this phase of crop is considered to be less influenced by seasonal changes.[1] However, it has been reported from Taiwan that some short-day varieties when grown during second crop season (January-April) failed to flower even after floral primordia formation presumably due to long days prevailing during the post-inductive periods.[2] Since information

on the effect of photoperiods during the post-inductive periods is meagre, the present investigation was undertaken to further elucidate the problem. The influence of external application of auxin (naphthalene acetic acid) on panicle emergence was also studied as it was known that extension growth of stem and ear emergence were influenced by auxin concentration during the post-inductive periods.[3]

A medium duration photosensitive *indica* rice, GEB. 24 (150 days) was raised in shallow pans and three seedlings per pot were transplanted on 27-1-1965 at 30-day stage of the crop. The plants were dissected out at periodical intervals to see the formation of the floral primordia. After the floral initiation was noticed under normal day lengths, the pots were exposed to (1) short day (8 hrs.), (2) long day (15 hrs.) (3) long day + NAA (10 ppm) as foliar spray at the commencement of treatment and (4) normal day ($12\frac{1}{2}$-13 hrs.). The date of complete emergence of panicle (main shoot) was taken as date of flowering and the data are tabulated in Table I.

TABLE I

Effect of the post-inductive photoperiods on flowering in rice

Treatment	Days to flower	
	Sowing to flowering	Primordial initiation to flowering
1 Normal day ..	112	26
2 Short day ..	113	27 (+ 1)*
3 Long day ..	133	49 (+23)
4 Long day + NAA ..	104	18 (− 8)

* (+) delay and (−) earliness in flowering over that of the normal plants.

As seen from Table I the flowering duration did not differ under normal and short day treatments, while significant delay in emergence was observed under long day treatment. However, the long day effect was completely nullified by the application of auxin and the emergence was even earlier than under short day.

It may be presumed that an auxin balance exists in flowering which is being disturbed under long days, which could be again restored by external application of auxin at optimal concentrations. Day length influences not only the floral initiation but also the elongation of floral axis and heading which is, in turn, controlled by the auxin concentration in the plant. These results corroborate the earlier observations[4] that external application of

auxins (IAA and NAA) helps in hastening of flowering in some rice varieties.

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SPORE DISCHARGE IN *HYSTERIUM TAMARINDI*

THE present note reports results of preliminary experiments on spore discharge using the "*Spore-Clock*" described by Ingold (1963). The genus *Hysterium* has been revised by Tilak and Rao (1966) and abundant material is available in this region.

The method and preparation of "*Spore-Clock*" were similar to that of Ingold's except for the "perspex disc" which has been replaced here by a disc holding 24 microscopic slides. There were 24 holes ($2 \cdot 5 \times 2 \cdot 5$ cm.) on the disc through which the lower surfaces of the slides were exposed to the material placed on wet filter-paper along with the host material.

The clock mechanism was adjusted so as to move the disc at the desired interval of time and bring the next slide in position. This was continued for a period of 24 hours.

Initially, distance *versus* spore discharge was determined in vertical range and it was found that maximum deposition occurred at 1 cm. and minimum at $1 \cdot 8$ cm. (Graph A).

A very pronounced diurnal rhythm of spore discharge is seen under condition of 12 hours darkness and 12 hours light in each 24 hours period. It shows a cycle of 24 hours with 2 peak-periods (Graph B) one in the forenoon (between 9 and 10 a.m.) and the other in the evening (between $17 \cdot 30$ and $20 \cdot 00$ p.m.).

The spore discharge starts at $9 \cdot 00$ a.m. and falls down completely before $10 \cdot 00$ a.m. There was no spore discharge till the evening. It again starts at $17 \cdot 30$ p.m. and reaches the peak at $18 \cdot 30$ p.m. and falls down completely before

20·00 p.m. Again no spore discharge was seen during the other period until the next morning.

The spore clock was used with the temperature between 23° to 29° C. However at 32° C. the spores were not at all discharged suggesting that during the high temperature and low humidity the spore discharge is retarded.

GRAPH A. Number of spores discharged plotted against distance. Readings are taken in Expt. I after 12 hours, in Expt. II after 24 hours and in Expt. III after 48 hours.

GRAPH B. Rate of spore discharge plotted against Time, under 12 hours light and 12 hours darkness in a 24 hours period.

Exposure to continuous light stops spore discharge while in continuous dark period the discharge follows the normal pattern described above.

Thanks are due to Dr. S. T. Tilak for guidance and encouragement.

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EMBRYOLOGICAL STUDIES IN *POLYSTACHYA FLAVESCENS*, (Bl) J. J. SMITH

THE family Orchidaceæ embryologically exhibits diversity in the development of the female gametophyte. Several genera have been subjected to embryological investigations. Schnarf (1931) and Swamy (1949) have reviewed the earlier studies on this family. Recent work includes the studies by Maheswari and Narayanaswamy (1952) on *Spiranthes australis* and Cococci (1964) on A.A. *Achalensis schlechter.*

The present work embodies the result of studies on the development of gametophytes in *Polystachya flavescens* (Bl) J. J. Smith (Syn. *Polystachya purpurea* Wt. Icon., and *P. Wightii*, Reichb.—Santapau and Kapadia, 1962). The plant belongs to the tribe Polystachyaceæ (Duplicate of monandrous Acranthe-Rendle, 1956). Embryological investigations have not so far been done in any member of this tribe. A few specimens were collected from Yercaud Shevaroy Hills and grown in our gardens.

The plant is a pseudo bulbous epiphyte bearing lanceolate obtuse districhous leaves. The flowers arise in acropetal succession. They are small bisexual trimerous bracteate and epigynous. The lateral sepals are broadly triangular, lanceolate and acute arising from a broad base. The lateral lobes are small and obtuse. The large mid lobe is tongue-shaped with rounded apex. The lateral petals are small and narrow and their margins overlap those of the large central labellum.

The single fertile stamen lies at the top of the column. The retinaculum originates at the top of rostellum and joins the two caudicles which run down from the two pollenia one for each anther lobe forming together a single apparatus.

The ovary is inferior, tricarpellary, syncarpous and unilocular. Three forked parietal placentæ arise from the ovary wall and become branched, each bearing many minute ovules.

The flower-buds of different stages were fixed in formalin acetic alcohol. The material was subjected to customary practice of dehydration and paraffin embedding and sectioned at 8-10 μ. Sections were stained in Heidenhain's iron alum hæmatoxylin and counterstained by erythrosin.

The ovules arise as small protuberances on the forked placental ridges. As development proceeds the ovules become anatropous. They are tenuinucellate and bitegmic (Figs. 1-3). The nucellus consists of an axial row of 5-6

cells being enveloped by the nucellar epidermis. The integuments are initiated at the megaspore mother cell stage. The micropyle is formed by the two-layered inner integument alone.

The hypodermal archesporial cell enlarges in size and functions directly as the megaspore mother cell, without cutting off any parietal cell. The megaspore mother cell undergoes the first meiotic division resulting in a dyad (Figs. 4-5). The micropylar dyad cell degenerates and the nucleus of the chalazal dyad cell undergoes three successive divisions forming eight-nucleate embryo-sac conforming to the Allium type (Figs. 6-10).

The egg apparatus consists of two lateral synergids and a median egg. The synergids are neither hooked nor beaked. The two polar nuclei are close to the egg in the act of fusion leading to the formation of secondary nucleus. The antipodals are usually composed of three nuclei, however antipodals are also two-nucleated in a few instances so that the embryo-sac is seven-nucleate (Fig. 10).

Transections of a young anther lobe reveals a group of microspore mother cells. The wall of the microsporangium consists of a tapetum, a middle layer, an endothecium and an epidermis. The tapetal cells remain uninucleate throughout and are of secretory type. This appears to be the general feature in Orchidaceæ. However, *Paphiopedilum druryi* is the only exception showing binucleate tapetal cells (Swamy, 1949).

The microspore mother cells by meiotic divisions give rise to tetrads of microspores which are of decussate, isobilateral and tetrahedral types (Figs. 11-14). The microspores do not separate from one another. The necleus of the microspore divides followed by a semi lunar wall formation to give rise to a generative cell and a vegetative cell. Subsequently the tapetum and the middle layer degenerate while the endothecium develops distinct fibrillar thickenings (Fig. 15).

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OCCURRENCE OF GYNANDROMORPHISM IN TASAR SILKMOTH (*ANTHERAEA MYLITTA* DRURY)

GYNANDROMORPHISM is a phenomenon of rare occurrence in organisms that normally produce males and females. The phenomenon though known in *Bombyx mori* L. since early 20th century[1] (Toyama, 1906), its occurrence has not been reported in *Antherœa mylitta* D. which produces the valuable Tasar silk of commerce.

Goldschmidt and Katsuki[2,3] (1927, 1928) reported genetically conditioned gynandromorph, *i.e.*, somatic mixture of male and female parts in *Bombyx mori* L. Many cases of gynandromorphs, induced artificially by X-radiation, centrifugation and high temperature have also been reported in *Bombyx mori*[4] L. (Tanaka, 1928).

FIGS. 1-15. Figs. 1-10. Stages in the development of embryo-sac, × 600. Figs. 11-13. Tetrahedral, decussate and isobilateral arrangement of microspores, × 600. Fig. 14. Pollenium showing 2-celled pollen-grains, × 600. Fig. 15. Endothecium showing fibrillar thickenings, × 500.

The authors in the present note have described gynandromorphs in *Antheræa mylitta* D. with special reference to the genitalia. The morphological characters of the gynandromorphic moths were examined and their genitalia dissected out to study the different parts.

Four cases of bilateral gynandromorphism were observed among the moths emerged out of 2,000 cocoons of Ampatia crop (1966) received from Chaibasa (Bihar). In this connection it may be mentioned that nearly eight samples of Tasar cocoons received from Madhya Pradesh, Orissa and Jammu were examined simultaneously but the occurrence of Gynandromorphs was not observed.

Strikingly enough, among the four gynandromorphic moths two were having male characters on the right half and the female characters on the left half, whereas in the other two it was just the reverse. It has further been observed that there is distinct dimorphism of the body colour on the two sides extending to all the parts including thorax, abdomen, legs and wings. In these moths the female side is yellowish and the male side brownish in colour. The most distinguishing feature of the female side is the presence of a narrow antenna and long wings and that of the male side the presence of broad antenna and smaller wings. The tip of the fore-wing of the female side forms a broad angle whereas that of the male is slightly curved and forms an acute angle. The size of the wing ocelli on female side is bigger than that of the male side (Fig. 1).

FIG. 1

On dissection, the genitalia shows (Fig. 2) that although the female ovipositor in the form of a prominent bilobed appendage is attached to the IX abdominal segment the female reproductive system is conspicuously lacking and the so-called vaginal opening acts as the atrophied male anal opening. The female copulatory aperture is not present. The

protractor and retractor muscles characteristic of a normal ovipositor[5] are also absent. The male genital parts are predominating. All the parts of a normal male[6] are present except gnathos and uncus. The male reproductive system together with the copulatory organ (Aedeagus) is present.

FIG. 2. Genitalia of a Gynandromorph of *Antheræa mylitta* D. (Antero-dorsal aspect). 1. Harpes; 2 Accessory clasper; 3. Ovipositor; 4. IX tergum (Tegumen); 5. Vaginal opening; 6. IX sternum (Vinculum); 7. Anellus; 8. Aedeagus; 9. Endophalic tube; 10. Ejaculatory duct; 11. Saccus.

It is interesting to note that in *Antheræa mylitta* D. while the expression of bilateral gynandromorphism is very distinct in its morphological characters in all the four cases, the female part is non-functional and the male part is dominant and functional, giving rise to Gynandromorphic males. Normal females when crossed with these Gynandromorphic males laid fertilised eggs.

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OCCURRENCE OF *ENTOMOPHTHORA FRESENII* (NOWAK), GUSTAF, ON GREEN BUG OF ARABICA COFFEE IN SOUTH INDIA

GREEN BUG, *Coccus viridis* (Green) is one of the major pests of coffee (*Coffea arabica* L.) in South India. It is subjected to attack by many natural enemies, amongst which the three entomogenous fungi, *Cephalosporium lecanii*, *Entomophthora lecanii* and *Hypocrella olivasiœ* are of practical importance.[1]

During the course of survey of natural enemies of the green bug at Coffee Research Substation, Chethalli in Coorg, some of the bugs were observed to be infested by a hitherto unknown entomogenous fungus subsequently identified as *Entomophthora fresenii* (Nowak) Gustaf and this is the first record on green bug in India. The detailed life-history of this species is given in Taxter's *Monograph on the Entomophthorœ of the United States*.[2] In the natural condition, the infested bugs appear like having a drop of lead paint on them. The fungus has no rhizoids or cystidia, the conidiophores are branched, there are spherical hyphal bodies and the conidia are smoke-coloured (the only species with coloured conidia). The specimen has been deposited in the Commonwealth Mycological Institute, London, under accession No. IMI 121481.

The author is grateful to the Director of Research for encouragement and to the Director, CMI, for identification.

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INDUCED VIRESCENT-BUD MUTATION IN *GOSSYPIUM HIRSUTUM*

VARIOUS workers over the past thirty-five years have shown that the tetraploid and diploid species of *Gossypium* share many phenotypic characters, most of which, when investigated, proved to have what appeared to be a common genetic base.[1-3] Here another such character is reported.

Work on the induction of mutations using ionizing radiations in Upland Cotton (*G. hirsutum*) is in progress at the Indian Agricultural Research Institute. Dry seeds of the variety PRS-72 and 74 (selections from Russian germ plasm) were irradiated with gamma-rays (25 kR) and sown. The M_1 plants thus obtained were selfed and the seeds were delinted and re-irradiated with gamma-rays (25 kR) and sown. This recurrently irradiated population was screened for chlorophyll mutation at different stages. In addition to the lethal types like *Xantha* and *Viridis* one non-lethal type of chlorophyll mutation was observed. In this mutant the cotyledons were green and normal but the true leaves were yellow-green (virescent green) to start with. As the terminal bud extended upwards the mature leaves turned green. Thus there was always yellow-green leaves at the apex of the mutant plants but the lower mature leaves were green. When the apical growing point was pinched off the laterals which arose exhibited the mutated pattern of chlorophyll pigmentation. The growth rate and vigour of these mutants were low compared to the control plants. Out of six such mutants one had a dichotomised main branch one of which was normal and the other exhibited the mutant phenotype.

These mutants had a striking resemblance to virsecent-bud mutant described in Asiatic diploid cotton.[4] The only difference appeared to be the normal pigmentation of cotyledons in *G. hirsutum*, while in diploid species even the cotyledons were virescent when first expanding.

Since this mutation arose in recurrently irradiated population it is difficult to draw any inference about the nature of inheritance of this mutation.

I am grateful to Dr. M. S. Swaminathan for his helpful suggestions and to the C.S.I.R. for the award of a Senior Research Fellowship.

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REVIEWS AND NOTICES OF BOOKS

Solution of Equations and Systems of Equations. (*Pure and Applied Mathematics*, No. 9). (Second Edition). By A. M. Ostrowski. (Academic Press, New York and London), 1966. Pp. xiv + 338. Price $ 11.95.

The scope of this book is indicated by the list of chapters contained therein : 1. Divided Differences ; 2. Inverse Interpolation. Derivatives of the Inverse Function. One Interpolation Point ; 3. Method of False Position (Regula Falsi) ; 4. Iteration ; 5. Further Discussion of Iterations. Multiple Zeros ; 6. Newton-Raphson-Method ; 7. Fundamental Existence Theorems for Newton-Raphson Iteration ; 8. An Analog of Newton-Raphson Method for Multiple Roots ; 9. Fourier Bounds for Newton-Raphson Iteration ; 10. Dandelin Bounds for Newton-Raphson Iteration ; 11. Three Interpolation Points ; 12. Linear Difference Equations ; 13. n-Distinct Points of Interpolation ; 14. $n + 1$ Coincident Points of Interpolation and Taylor Development of the Root ; 15. The Square Root Iteration ; 16. Further Discussion of Square Root Iteration ; 17. A General Theorem on Zeros of Interpolating Polynomials ; 18. Approximation of Equations by Algebraic Equations of a Given Degree. Asymptotic Errors for Simple Roots ; 19. Norms of Vectors and Matrices ; 20. Two Theorems on Convergence of Products of Matrices ; 21. A Theorem on Divergence of Products of Matrices ; 22. Characterization of Points of Attraction Repulsion for Iterations with Several Variables ; 23. Further Discussion of Norms of Matrices ; 24. An Existence Theorem for Systems of Equations ; 25. n-Dimensional Generalization of the Newton-Raphson Method. Statement of the Theorems ; 26. n-Dimensional Generalization of the $\triangle$ (A) Newton-Raphson Method. Proofs of the Theorems ; 27. Method of Steepest Descent. Convergence of the Procedure ; 28. Method of Steepest Descent. Weakly Linear Convergence of the $\xi \mu$; and 29. Method of Steepest Descent. Linear Convergence of the $\xi \mu$.   C. V. R.

Specific Heats at Low Temperatures. By E. S. R. Gopal. (Heywood Books, London), 1966. Pp. x + 240. Price 70 *sh.*

This book surveys the field of low-temperature specific heats at a level suitable for graduate courses. After outlining the thermodynamic background, specific heat behaviour of solids, liquids, and gases is discussed in detail. The account is kept at an elementary level, but references to advanced treatments are given. Students unfamiliar with the field will find in this a supplementary text which can function as a bridge between basic theory and modern research work. Considerable practical information is included as well on calorimetric and refrigeration problems ; for instance, the basic theory, tables, and supplementary information is given to enable the reader to calculate the refrigeration needed to cool any piece of apparatus to a desired point.   C. V. R.

Italian Physical Society (Course 32). (*Weak Interactions and High-Energy Neutrino-Physics*). By T. D. Lee. (Academic Press, New York and London), 1966. Pp. xi + 334. Price $ 16.00.

This book contains the Proceedings of the International School of Physics "Enrico Fermi", Course XXXII held at Varenna on Lake Como, Villa Monastero, from 15th to 27th June 1964. The Director of the Course was Prof. T. D. Lee, and it was attended by 55 members.

This book provides a background in weak interactions and high-energy neutrino physics for both the advanced graduate student and the research worker.

The contents of this volume are : G. Bernardini, Opening Speech ; G. Bernardini, Weak Interactions ; C. S. Wu, Beta-Decay ; H. Primakoff, Theoretical Survey of Muon Physics ; L. M. Lederman, Muon Physics ; T. D. Lee, Theoretical Survey of High Energy Neutrino Interactions ; M. Schwartz, Neutrino Experiments ; L. M. Lederman, Present Neutrino Experiments ; M. Veltman, N* Production by Neutrinos ; R. H. Dalitz, Properties of Weak Interactions ; J. Steinberger, Experimental Survey of Strange-Particle Decays ; N. Cabibbo, Weak Interactions and the Unitary Symmetry ; T. D. Lee, Mass Formulæ and SU_3 Symmetry ; and S. Naranan, Cosmic Ray Studies of High Energy Strong and Weak Interaction Processes.   C. V. R.

Studies on Chemical Structure and Reactivity : Presented to Sir Christopher Ingold. Edited by J. H. Ridd. (Methuen and Co., Ltd., 11, New Fetter Lane, London E.C. 4), 1966. Pp. viii + 290. Price 50 *sh*. Net in U.K. only.

In September 1965, Sir Christopher Ingold completed thirty-five years as a Professor of Chemistry at University College, London. This book is presented to Sir Christopher by past and present members of his department as a tribute to his achievements and as a token of regard. Almost all the contributions are directly related to Sir Christopher's own work. They deal with a small number of topics representative of his investigations during the past thirty-five years. These topics have been made the subject of reviews dealing with aspects of current interest.

The titles of the topics dealt with in this volume are listed below : 1. The Closed Shell in Molecules, by D. P. Craig ; 2. Allylic Shifts : Heterolysis, Mesomerism, and Duality of Mechanism, by P. B. D. De La Mare and C. A. Vernon ; 3. The Transition States of Olefin-forming E_2 Reactions, by D. V. Banthorpe ; 4. Quasi-Heterolytic Gas-Phase Reactions, by Allan Maccoll ; 5. Nucleophilic Substitution and the Walden Inversion, by C. A. Bunton ; 6. The Spectrum and Structure of Benzene, by T. M. Dunn ; 7. The Mechanism of Nitration in Organic Solvents, by J. H. Ridd ; 8. Oxides, Oxyacids, and Oxyhalides of Nitrogen, by D. J. Millen ; 9. Cryoscopy in Sulphuric Acid, by R. J. Gillespie ; 10. Molecular Geometry and Electronic Excitation, by Gerald W. King ; 11. The Steric Courses of Octahedral Substitution, by M. L. Tobe ; 12. Electrophilic Substitution at a Saturated Carbon Atom, by F. G. Thorpe ; 13. Sir Christopher Ingold and the Chemistry Department, University College, London, by J. H. S. Green ; and 14. The Future of the Department, by R. S. Nyholm.   C. V. R.

Methods in Cell Physiology (Vol. II). Edited by David M. Prescott. (Academic Press, Inc., New York and London), 1966. Pp. xvi + 426. Price $ 17.50.

This multi-authored volume, the second of a series, presents a comprehensive review of selected basic methods techniques employed in cell biology. Emphasis is placed upon developments in high-resolution autoradiography, especially at the electron microscope level. Also considered are techniques of micro-manipulation on single cells and nuclei, and the methodology for measuring phases of the cell life-cycle in tissue cells. Included in each chapter are comments on the limitations, advantages and accuracy of various methods. Research workers and graduate students in biology, biochemistry, biophysics, zoology, cytology, and general physiology will find these procedures to be of great interest.   C. V. R.

Thermodynamics : Principles and Applications to Engineering. By Dr.-Ing. Ernst Schmidt. (Authorized Translation from the Third German Edition. By J. Kestin). (Dover Publications, Inc., New York), 1966. Pp. xvii + 532. Price $ 3.00.

This Dover edition, first published in 1966, is an unabridged and corrected republication of the work originally published by the Oxford University Press, 1949. This edition contains a new Preface by the translator. The titles of the chapters are as follows : Temperature and Quantity of Heat ; The First Law of Thermodynamics ; The Thermodynamic State of a Body ; The Perfect Gas ; Thermodynamic Cycles ; The Second Law of Thermodynamics ; The Application of the Gas Laws and of the First Two Laws of Thermodynamics to Engines with a Gaseous Working Fluid ; The Properties of Vapours ; Solidification and Solids ; The Steam Engine ; Equations of State of Vapours ; Combustion ; The Flow of Gases and Vapours ; Turbines and Turbocompressors ; The Fundamentals of Heat Transfer ; Heat Transfer by Radiation ; Mixtures of Gases and Vapours.   C. V. R.

Annual Review of Phytopathology (Vol. 4). Edited by J. G. Horsfall. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306, U.S.A.), 1966. Pp. vii + 423. Price $ 8.50 per copy (U.S.A.) and $ 9.00 (elsewhere).

The contents of this volume are as follows : Whither Pathology, by D. L. Bailey ; Measuring Plant Disease, by E. C. Large ; Fungi as Vectors and Hosts of Viruses, by R. G. Grogan and R. N. Campbell ; Chemical Treatments and Inoculum Potential of Soil, by Stephen Wilhelm ; Mechanical Transmission of Viruses of Woody Plants, by Robert W. Fulton ; Problems of Air Pollution in Plant Pathology, by E. F. Darley and J. T. Middleton ; Poetic Enzymes in Tissue Degradation, by Durward F. Bateman and Roy L. Millar ; Natural Resistance of Wood to Microbial Deterioration, by Theodore C. Scheffer ; Fungus Toxins Affecting Mammals, by P. J. Brook and E. P. White ; Behaviour of Zoospores

in Plant-Pathogenic Phycomycetes, by C. J. Hickman and H. H. Ho ; Nucleic Acid Metabolism in Obligate Parasitism, by Rudolf Heitefuss ; Recent Developments in the Genetics of the Host-Parasite System, by Peter R. Day ; Genetics of Powdery Mildews, by John G. Moseman ; Epidemiological Relations of the Pseudomonad Pathogens of Deciduous Fruit Trees, by J. E. Crosse ; Dynamics of Seed Transmission of Plant Pathogens, by Kenneth F. Baker and Samuel H. Smith ; Synergism Among Fungicides, by Anna Scardavi ; Amino-Acids and Plant Diseases, by O. M. van Andel ; Action of Oil in the Control of Plant Disease, by Lucas Calpouzos.   C. V. R.

A Simple Approach to Electronic Computers (Second Edition). By E. H. W. Hersee. (Published by Gordon and Breach, New York), 1967. Pp. 261. Price $ 7.50.

The book presents in some detail, and as simply as possible, a few of the basic working principles of both digital and analogue computers. The first edition was published in 1959. The second edition which has been revised and enlarged includes much additional material. The book will appeal to laymen interested in modern advances to know how a computer works. To a student it will serve as a useful introduction to the more advanced text-books on the subject.   A. S. G.

The Fungi (Vol. II) (*The Fungal Organism*). Edited by G. C. Ainsworth and A. S. Sussman. (Academic Press, Inc., Publishers, 111, Fifth Avenue, New York, N.Y. 10003). Pp. 805. Price $ 27.00.

The first volume of this 3-volume advanced treatise on fungi was reviewed in *Current Science*, July 5, 1966, p. 347. It treated fungi at cellular level. The second volume is devoted to fungal organism. The transition from cell to organism is provided by the first chapter which deals with Protoplasts of Fungi. This is followed by chapters on aggregation of unicells (yeasts), and accounts of multicellular vegetative and sporulating structures of increasing complexity. Mechanisms of morphogenesis deal with Dimorphism and its physiological basis, Morphogenesis in the Myxomycetes, Cellular slime molds (Acrasiales), Aquatic fungi

(Phycomycetes), Ascomycetes, and Basidiomycetes. Several chapters are devoted to the Physiology of Reproduction and Inheritance. Finally the topic on Dissemination is covered by accounts on Spore release, dispersal, and dormancy and spore germination. Twenty-three authors have contributed to the 23 chapters in the book. There is no doubt that this set of three volumes, providing critical reviews of recent investigations on all aspects of fungi will remain a reference literature for some years to come.   A. S. G.

The Analysis of Physical Measurements. By E. M. Pugh and G. H. Winslow. (Addison-Wesley Publishing Co., Inc., 10-15, Chitty Street, London W. 1), 1966. Pp. 246. Price $ 4.75.

This is an introductory text-book on theory of errors and statistical analysis suitable for undergraduates majoring in science or engineering. The treatment is clear and comprehensive. The chapters are graded, thus starting from comparatively elementary levels with discussions on analysis of observations, accuracy, approximations and use of graphs they go through probability laws, method of least squares, propagation of errors, and finally to statistical analysis. Mathematical appendices included at the end will make the book self-contained.

The book can be used not only as a text-book but also as a reference book by professional experimentalists.   A. S. G.

Books Received

The Phase Rule and Heterogeneous Equilibrium. By J. E. Ricci. (Dover Publications, New York). Pp. xv + 505. Price $ 3.25.

The Photochemistry of Gases. By W. A. Noyes Jr. and P. A. Leighton, (Dover Publications, New York), 1966. Pp. 475. Price $ 3.00.

Microscopy for Chemists. By H. F. Schaeffer. (Dover Publications, New York), 1966. Pp. viii + 264. Price $ 2.00.

Introduction to Statistical Mechanics. By R. W. Gurney. (Dover Publications, New York), 1966. Pp. vii + 268. Price $ 2.00.

Laplace Transform Theory and Electrical Transients. By S. Goldman. (Dover Publications, New York), 1966. Pp. xlv + 439. Price $ 3.00.

VIBRATIONAL SPECTRA AND NORMAL CO-ORDINATE TREATMENT OF OXAMIDE AND d-OXAMIDE

(MRS.) LALITHA SIRDESHMUKH

Physics Department, Osmania University, Hyderabad-7

THE Raman spectrum of solid oxamide and the infra-red spectra of oxamide and deuterated oxamide have been reported by earlier workers.[1-3] Scott and Wagner[3] have assigned the various fundamentals on the basis of C_{2h} symmetry. In the present work the infra-red spectra of oxamide and deuterated oxamide were recorded and a normal co-ordinate treatment was carried out to check the assignment on the basis of potential energy distribution among various symmetry co-ordinates for each normal mode of vibration.

The samples were used both in the nujol mull and KBr pellets in the region 4000–400 cm.$^{-1}$ The spectra were recorded with a Perkin-Elmer 221 spectrophotometer in the region 4000–700 cm.$^{-1}$ with NaCl optics and with a grating spectrophotometer model 337 in the region from 700–400 cm.$^{-1}$ The deuteration was done by exchange with D_2O and removal of water under vacuum. After about three exchanges almost complete deuteration was obtained. The spectra are shown in Figs. 1 and 2.

FIG. 1. Infra-red spectra of oxamide (—) and deuterated oxamide (– – –) in KBr pellet.

FIG. 2. Infra-red spectra of oxamide (—) and deuterated oxamide (– – –) in nujol mull.

Wilson's[4] F-G matrix method was used to evaluate the potential constants with a general quadratic potential function. When NH_2 is considered as a single mass point the problem reduces to the calculation of the vibrational modes for a molecule of six-body type. The molecule will have twelve fundamental modes with the distribution $5 A_g + B_g + 4 B_u + 2 A_u$. The calculated frequencies of the nine planar modes are compared with the observed values in Table I. The main stretching force constants used are $f_{CO} = 3·5$ md/Å, $f_{C-N} = 7·5$ md/Å and $f = 9·7$ md/Å.

TABLE I

Observed and calculated frequencies
(in cm.$^{-1}$)

Oxamide		Deuterated oxamide		
Observed	Calculated	Observed	Calculated	Assignment
1762* (Raman)	1719	..	1716	ν (CO) A_g
1483 ,,	1481	..	1469	ν (CN) ,,
800 ,,	820	..	800	ν (CC) ,,
448 ,,	436	..	426	ρ (OCN) ,,
357 ,,	378	..	366	δ (OCN) ,,
1668 (Infra-red)	1667	1652	1663	ν (CO) B_u
1343 ,,	1327	1370	1399	ν (CN) ,,
640 ,,	640	625	625	δ (OCN) ,,
..	230	..	224	ρ (OCN) ,,

* Raman frequencies.

From a study of the potential energy distribution among the symmetry co-ordinates it was possible to assign the two lower fundamentals with certainty. They are the 357 cm.$^{-1}$ and 448 cm.$^{-1}$

bands observed in Raman spectrum w been assigned to the δ(OCN) ben ρ(OCN) rocking modes of the type A tively. Scott and Wagner have ass band at 640 cm^{-1} to the (OCN) bend of the type B_u and the corresponding deuterated oxamide as 569 cm.^{1} The value for the deuterated oxamide is be 625 cm.$^{-1}$ The band observed at 6 assigned to this mode and the 569 cm to the ND_2 wagging mode which corre the 792 cm.$^{-1}$ of the undeuterated spe

From Table I, it is seen that the quency increases on deuteration. S Wagner have attributed this effect different amount of coupling between bending and C–N stretching modes as to the coupling between ND_2 bending stretching modes of the deuterated spec could be tested by treating the molecule body problem to evaluate the potenti distribution. This work is in prog would be published in due course.

It is a pleasure to thank Dr. P. G. Pu his keen interest and encouragement d progress of this work. Thanks are also Director, Regional Research Laboratory abad, and to the Head of the Depar Chemistry, Osmania University, for la facilities. The author is grateful to the for the award of a Post-Doctoral Fe

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STUDIES ON DRIFTS IN THE E REGION AT WALTAIR

P. S. KESAVA RAO AND B. RAMACHANDRA RAO

Ionosphere Research Laboratories, Physics Department, Andhra University, Waltai

1. VARIATION OF DRIFT SPEED AND DIRECTION WITH HEIGHT

NOT much work has been reported on the height variation of drift speed and direction at low latitudes. The present investigation has therefore been undertaken using the data of drift speeds and directions obtained on at different virtual heights in the ionosphere by the similar fades analysis of fading records due to Mitra.[1] Theoretical investigations by Booker[2] and experimental

studies by Jones[3] provide the justifica assuming that the level corresponding drift is close to the reflection level of th waves.

For the evaluation of height gradier speeds and drift directions obtained 1962-64 for virtual heights ranging 100-110, 110-120, 120-130 and 130-140 grouped and the average values of dri and direction in each of these ran presented in Table I along with the

gradients. It can be seen from the table, that the height gradient of drift speed, which is positive and fairly constant, has an average value of 0·59 m./sec./km. in the entire height range of 100–140 km. in E region. The drift direction is negative (*i.e.*, rotating in an anti-clockwise sense with increase of height) in the height range of 100–120 km. and positive in the remaining height ranges.

TABLE I

Variation of average values of drift speed and direction with height

Height range in km.	Average height (km.)	Average value of		Height gradient of	
		Drift speed (m./sec)	Drift direction (E of N)	Drift speed (m./sec./ km.)	Drift direction (degrees/ km.)
100–110	105	66·4	158°	0·62	−0·76
110–120	115	72·6	150·4°	0·54	0·22
120–130	125	78·0	152·6°	0·62	0·86
130–140	135	84·2	161·2°		

The value of height gradient of drift speed obtained in the present investigation is much less than that reported from high latitudes by Elford and Robertson[4] and Greenhow[5] who estimated height gradient of drifts using meteor trails. As the observations in the present investigation refer to higher levels in the E region for a low latitude station, complete agreement need not be expected. Rao and Rao[6] and Rao and Rao[7] reported the height gradients of drift speed of 0·74 and 0·72 m./sec./km. at Waltair for the periods 1957–59 and 1960–62 respectively, values which are higher than that obtained in the present study which covers the period 1962–64. Considering the results of height gradient for the three periods referred to above, we arrive at the interesting and new result that the height gradient of drift speed decreases with sunspot activity.

The observed rotation of the drift vector, with height in an anticlockwise sense in the height range of 100–120 km., agrees well with a similar result obtained by Manring *et al.*[8] by sodium vapour trail method. As height variation of drift direction has not been studied at low latitudes by similar fades method, no such comparison could be made with the results of the present investigation.

II. EFFECT OF MAGNETIC ACTIVITY ON HORIZONTAL DRIFTS

The study of the effect of magnetic activity on horizontal drifts in the E region is relevant for a complete understanding of the origin of drifts. In view of the importance of this study, the drift data (obtained by similar fades analysis) for the E region taken on 2·0 Mc./sec. by spaced receiver method for the period 1962–64 at Waltair (17° 43′ N., 83° 18′ E.; Geo. Mag. Lat. 7·4° N.) is divided into three-hour groupings corresponding to the magnetic K index data of Alibag (Geo. Mag. Lat. 9·5° N.) which provides only one K index for every three-hour interval commencing from 0000 hrs. G.M.T.

The average value of drift speed for each of these three-hour periods is taken as the representative drift speed of the corresponding K index. The values of drift speeds corresponding to each particular value of K index were averaged for the periods 1962–63, 1963–64 and 1962–64 separately and the variation of this average drift speed with K index for the above periods is presented in Fig. 1. It can be seen from the plots that positive correlation exists between the E region drift speed and magnetic activity throughout the period 1962–64. The slopes of the straight lines in Fig. 1 are almost equal and the change of drift speed for unit change of K index in the present investigation came out to be 5 m./sec. In order to study the variation of NS and EW components of drift velocity with K index, all the drift speeds obtained during the present investigation were resolved into NS and EW components. The average values of NS and EW components for each value of K index were calculated taking the sign into consideration. The variations of the average values of NS and EW components with K index for 1962–64 are presented in Fig. 2. From a perusal of Fig. 2, it can be concluded that the variations of NS and EW components with K index are similar except for minor changes. It will be observed that the NS component is towards south for K indices less than 1 and greater than 5 and north for the remaining K index values. On the other hand, the EW component was found to be towards west for K indices less than 1 and greater than 4 and towards east in the remaining K indices.

Results of similar investigation are not available for any low latitude station other than Waltair. However, it is interesting to note that investigations at high latitudes by Chapman[9] and Briggs and Spencer[10] did not reveal any systematic variation of total drift speed or NS or EW components with magnetic activity upto K index of 5. For higher K values

FIGS. 1-2. Fig. 1. Variation of E Region drift speed with magnetic K index for different periods. Fig. 2. Variation of NS and EW components of drift velocity with magnetic K index in the E region.

they found positive correlation between E region drift speed and magnetic activity. Utilising the data for the period 1960-62, Rao and Rao[11] studied the effect of magnetic activity on E region drift speed and obtained a value of 2·3 m./sec./unit change of K index. The value of 5 m./sec./unit change of K index obtained in the present study is much higher and this may be due to the fact that the period under study is of low sunspot activity compared to the period 1960-62.

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MEIOTIC BEHAVIOUR OF ABERRANT HYPOPLOID MICROSPOROCYTES IN *TRITICUM ZHUKOVSKYI* Men. et Er.

M. D. UPADHYA

Indian Agricultural Research Institute, New Delhi

EXPERIMENTAL evidence was presented by Upadhya and Swaminathan[3,4] to show that *T. zhukovskyi*, a new hexaploid wheat, arose as an amphidiploid from the cross between *T. timopheevi* and *T. monococcum* and has the genomic constitution AAAABB.

During the course of meiotic studies in *T. zhukovskyi* in one of the anthers microsporocytes were observed which had aneuploid chromosome complements along with cells having $2n = 42$ chromosomes. Fourteen cells out of 16 were at the first meiotic metaphase and the rest two at the first anaphase. The two cells

found at the first anaphase had 21 chromosomes each. In one of the cells 8 and 6 chromosomes were at either poles while 7 were at the equatorial region, whereas in the second cell 9 and 7 chromosomes were at the poles and 5 at the equatorial region. The data on the meiotic behaviour of the fourteen cells are given in Table I.

It will be observed from Table I that the cells show, apart from bivalents and univalents, higher associations of chromosomes forming tri-, quadri-, penta-, hexa- and heptavalents. The frequency of trivalents and quadrivalents is the

TABLE I

Chromosome associations at M 1 of meiosis in cells with reduced chromosome numbers

Cell No.	Chromosome number	Chromosome associations	Bivalents Rings	Bivalents Rods
1	35	$^1VI\ ^{14}II^{+1}I$	10	4
2	35	$^1VII^{+1}IV^{+12}II$	9	3
3	35	$^1V^{+2}IV^{+11}II$	7	4
4	30	$^1III^{+12}II^{+3}I$	10	2
5	21	$^1IV^{+1}III^{+7}II$	6	1
6	21	$^1IV^{+1}III^{+5}II^{+4}I$	2	3
7	21	$^7II^{+7}I$	3	4
8	21	$^1IV^{+4}II^{+0}I$	4	0
9	21	$^1IV^{+1}III^{+3}II^{+8}I$	3	0
10	17	$^1IV^{+3}II^{+7}I$	3	0
11	15	$^1III^{+1}II^{+10}I$	0	1
12	14	$^1VI^{+8}I$	0	0
13	13	$^1II^{+11}I$	0	1
14	13	$^4II^{+5}I$	4	1

highest among the higher associations. The aberrant cells thus show a characteristic behaviour in having multivalent chromosome associations in almost all the cells studied.

Sachs[2] had observed aberrant cells having hypoploid chromosome numbers in the $6x$ amphidiploid synthesised from the cross *T. dicoccoides* and *T. bœticcm*. Out of 13 cells observed by him, only two cells had one trivalent each while rest of the associations consisted of bivalents and univalents. The genome constitution of this amphidiploid was AAAABB. *T. zhukovskyi* has been shown to have the AB genomes from *timopheevi* and the third A genome from *monococcum* to give it the genomic constitution as AAAABB. The only significant difference between the artificial $6x$ amphidiploid reported by Sachs[2] and *zhukovskyi* is the source of the B genome. In the former it was derived from *dicoccoides* while in the later it was derived from *timopheevi*. The aberrant cells observed in the two cases differ very significantly in the degree of multivalent chromosome associations. This then leads to a clear indication that, whereas the mechanism of the B genome from *dicoccoides* shows a very high degree of control over the multivalent formation, the mechanism of the B genome from *timopheevi* does not. Although in both the artificial amphidiploid and *zhukovskyi* the rest of the genomic constitution with regard to the A genomes is similar.

A review of the observations on the meiotic behaviour of the aberrant cells, having subnormal number of chromosomes observed in established varieties and intraspecific hybrids in *T. œstivum*, indicates that such cells usually show univalents and bivalents. While the multivalent chromosome associations such as tri-, quadrivalents or higher associations were rarely observed.[5] Therefore, it is clearly indicated that the multivalent suppression mechanism evolved by the B genome in the polyploid wheat species, other than belonging to the *timopheevi* group, share a distinct property of the suppression of multivalent formation in the aberrant cells with aneuploid complements.

Based on the aforementioned observations, it is reasonable to infer that the B genomes from *dicoccoides* (from *turgidum* complex according to Mac Key[1]) and *timopheevi* differ in their multivalent suppression characteristics. From their studies, Upadhya and Swaminathan[4] had concluded that probably the gene/s system, similar to that found in chromosome 5 B of *vulgare*, may not be present in *zhukovskyi*. Further, that the AB component of *zhukovskyi* derived from *timopheevi* may represent a primitive state of the 5 B mechanism of the tetraploid *Triticum* complex.

These data therefore lend further support to the suggestion of Upadhya and Swaminathan[4] that probably the B genome of the *timopheevi* group represent a primitive stage in the evolution of the B genomes of the other tetraploid *Triticum* complex, and that the multivalent suppression mechanism of the B genome in other tetraploid forms is the evolved form of that of the B genome of *timopheevi*.

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3

PECTIN AND POLYGALACTURONATE *TRANS*-ELIMINASES IN *FUSARIUM MONILIFORME* AND *CEPHALOSPORIUM SACCHARI*

R. KATHIRVELU AND A. MAHADEVAN

Microbiology Laboratory, Faculty of Agriculture, Annamalai University, Annamalainagar

FROM cane varieties CO 449 and CO 658, exhibiting wilt symptoms, *Fusarium moniliforme* Sheldon and *Cephalosporium sacchari* Butler were isolated. Extensive occurrence of macerated pith tissues with brown discolouration has been reported to be the typical internal symptom of the disease. Tissue maceration has been attributed to the activity of cell-wall dissolving enzymes[1,2] and both the pathogens are known to produce such enzymes.[3,4] Recently Sherwood[5] and Mahadevan and Chandramohan[6] showed that *trans*-eliminase types of pectic enzymes caused tissue maceration. The production of *trans*-eliminases by *F. moniliforme* and *C. sacchari* is reported in this note.

In 500 ml. Erlenmeyer flasks, 25 g. of wheat bran and 15 ml. water were mixed, sterilized, separately inoculated with the isolates and incubated at room temperature (28 ± 2° C.) for 6 days. Two drops of toluene and 200 ml. distilled water were added to the growth, allowed to autolyse for 12 hr., filtered through a cheese cloth, centrifuged at 3,000 rpm. for 15 min. and the clear supernatant was used as the enzyme.[7] The enzyme activity was determined by the loss in viscosity of sodium polypectate or pectin at pH 8·6 in an Ostwald-Fenske viscometer size 300 at 30° C. in a water-bath. The reaction mixture consisted of 4 ml. of 1·2% pectin or sodium polypectate at pH 8·6 in boric acid-borax buffer, 1 ml. of the buffer and 2 ml. of the filtrate at pH 8·6.[6] Maceration of potato medullary discs was determined by placing 5 potato discs of 1 mm. thickness, 9 mm. diameter in a sterile petri-dish containing 15 ml. of the filtrate at pH 8·6, 1 ml. of 4% sodium fluoride (against contaminants) and testing the coherence of discs by touching them with a glass rod at 4 hr. interval.[8]

The autolysed filtrates of *F. moniliforme* and *C. sacchari* reduced the viscosities of pectin and sodium polypectate and macerated potato discs within 24 hr. *Fusarium* produced more of the enzyme than *Cephalosporium*; the viscosity losses of sodium polypectate and pectin were respectively 35 and 27% with the former while in the latter, they were 29 and 22% at the end of 2 hr. When the enzyme substrate mixture was analysed for the presence of thiobarbituric

acid (TBA) reacting substances (to 3 ml. of the clarified mixture, 10 ml. of 0·01 M thiobarbituric acid and 5 ml. of 0·5 N HCl were added, boiled in a boiling water-bath for 1 hr., cooled, the volume was made up and the percent transmittance was determined in a Beckman DU Spectrophotometer at a wavelength of 480–580 mμ), it was found that the maximum absorption was at 547 mμ, indicating that *trans*-eliminative split of pectic substances occurred. TBA reacting substances were also released by the enzyme preparation from potato cells. The *trans*-eliminative split of pectin and sodium polypectate by the culture filtrates was conclusively demonstrated on the basis of increased absorption maximum of the clarified reaction mixture at 232 mμ determined in a Beckman DU Spectrophotometer at a wavelength of 210–310 mμ[9] (the reaction mixture was clarified by precipitating the enzyme proteins with 3 ml. of 5% trichloro-acetic acid). Hence based upon subtsrate specificity, the release of TBA-reacting substances and increased absorption maximum of reaction mixture at 232 mμ, it may be concluded that both the fungi produced in the wheat bran medium pectin and polygalacturonate *trans*-eliminases.[10] Singh[3] showed that enzyme preparations of *F. moniliforme* and *C. sacchari* macerated potato discs especially in a pH range of 7·8–8·6. It is likely that *trans*-eliminases might have been involved in the various enzyme sources used by Singh.

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TOXICITY OF SIX ORGANOPHOSPHORUS INSECTICIDES TO FISH

A. SREENIVASAN AND G. K. SWAMINATHAN

Fisheries Hydrobiological Research Station, Madras-10

WITH the increasing use of agrochemicals for crop protection, the possible hazard to fish in ponds and reservoirs also increases. The run-off water is also likely to contaminate rivers. During aerial spraying for the control of hairy caterpillar with endrin, mortality of fishes in wells has been reported. It was therefore felt necessary to determine the relative toxicity of insecticides to fish. A study[1] was already made of the toxicity of endrin to fish. In this note, the results of studies on the effect of organophosphorus insecticides to fish and frog tadpoles are reported.

Static, constant volume bioassays as described by Doudoroff *et al.*[2] were performed. The experimental fish used were of size 2·5 to 6·0 cm. generally except that *C. mrigala* and *L. fimbriatus* were of size 1·0-2·0 cm. (early fry). The test animals were conditioned for 48 hours prior to use. 20 l. glass aquaria jars with 10 l. water were used in the bioassays. Two early fry or one advanced fry per litre of water were used. The medium had the range of composition indicated in Table I. The final dissolved oxygen was not allowed to drop below 5·0 mg./l. The median tolerance limit (TLm) as well as the lethal concentration killing 100% of fish (LC_{100}) were noted for the duration of 48 hours. The results are presented in Table III. The concentrations of the chemicals used are furnished in Table II.

TABLE I

Quality of the water in the bioassay of pesticides

Parameters	Experiments with metasystox, parathion, malathion	Experiments with phosphamidon and nuvan	Experiment with folidol
Temperature ° C. ..	25·7-29·9	28·5-28·8	30·5
Dissolved oxygen mg./l:			
Initial ..	13·8-14·2	13·4-14·4	11·4
Final ..	5·4- 8·2	6·8- 9·2	6·8
Free CO_2 mg./l. ..	1·1- 2·10	1·5	1·2
Total alkalinity ($CaCO_3$ mg./l.)	43·5-91·0	47·2-66·8	68·1
pH ..	7·0- 7·5	7·1	7·0
Hardness mg./l. ($CaCO_3$)	64-96	..	..

TABLE II

Active ingredients in the commercial preparations used

Name of the insecticides as used in the tests	Manufacturers	Active ingredient
Paramar-50 ..	Hexamar	50% parathion
Malamar-50 ..	,,	50% malathion
Folidol E.605 ..	Bayer	5% ethyl parathion
Metasystex ..	,,	25% matasystox
Dimecron ..	Ciba	100% phosphamidon
Nuvan 100 EC ..	,,	100% DDVP

TABLE III

Toxicity of six-organophosphorus insecticides to certain species of fish

Species tested	Paramar-50 TLm	Paramar-50 LC_{100}	Malamar-50 TLm	Malamar-50 LC_{100}	DDVP TLm	DDVP LC_{100}	Metasystox TLm	Metasystox LC_{100}	Folidol TLm	Folidol LC_{100}	Dimecron TLm	L C_{100}
Cyprinus carpio (Bangkok strain)	6·5	9·0	10·0	13·5	15·0	22·5	9·0	18·5	..	..	51·5	76·0
C. carpio (German)	..	..	8·5	16·0	5·5	9·5	20·0-25·0	30·0	..	..	..	..
Tilapia massambica	4·0-5·0	6·0-7·0	8·3	10·0	3·0	6·8	12·0-12·5	20·0	0·6	0·8	..	..
Cirrhina mrigala	5·0	8·5	7·0	15·0	25·0-30·0	35·0-40·0	17·0	31·5	..	..	..	..
Labeo fimbriatus	7·5	10·0	8·5	12·0	18·0	37·5	16·0	28·5	..	..	..	..
Danio sp.	..	..	13·5	14·0	..	..	..	..	..	..	..	..
Labeo rohita	..	..	8·0	10·0	..	..	..	..	..	..	..	..
Barbus machecola	2·0	2·5	..	..	..	..	..	..	..	..	..	..
Frog tadpoles	..	..	..	..	10·0	18·0	..	..	..	>50·0	..	..
Gambusia affinis	..	..	..	..	..	..	..	..	0·1	0·2	..	..

From the results, it is clear that folidol is the most toxic among the organophosphorus chemicals, the TLm 48 hours for *Tilapia* being 0·6 ppm. 'Dimocron' (Phosphomidon) was the least toxic, while DDVP and metasystox were only less toxic than the phosphorothionates (parathion and malathion). Schouwenburg and Jackson[3] found that the TLm of Phosphamidon to Coho salmon was about 7·4 ppm which value is very much lower than ours. Muncy and Oliver[4] found a low TLm value of 6·0 ppm for phosphamidon for red Crawfish, while our values are high. They also found that malathion upto 20 ppm was not toxic, whereas for our fishes this dosage was quite lethal. The values obtained by Henderson and Pickering[5] for fathed minnows are nearly comparable with our values for parathion and malathion. Lahav et al.[6] in Israel obtained rather high values for the toxicity of malathion and DDVP to carp. They found that upto 30 ppm of 50% DDVP was not toxic to carp for 96 hours and that the LC_{100} for carp of malathion was 35 ppm. The TLm 48 hours values for DDVP and metasystox obtained by Kimura and Matida[7] for common carp, goldfish and trout were less than the values reported here by us. In fact DDVP was found to be highly toxic by these Japanese workers, whereas for their fish ethyl parathion was not so toxic as recorded by us. Pickering et al.[8] however found as low as 0·01 ppm malathion to kill 40% of blue gills. Carlson[5] also recorded similar low values—48 hr. TLm for blue gill sunfish being 0·14 ppm. Robeck et al.[10] determined the TLm 96 hr. of parathion to bluegill to be 0·7 ppm.

There appears to be differential toxicity based on species. With regard to parathion and malathion, the difference was not much. DDVP was 10 times more toxic to *Tilapia* than to *mrigal* (48 hr. TLm being 3·0 ppm and 30·0 ppm respectively). It was also more toxic to the German strain of carp than to the Bangkok strain. Frog tadpoles, which resisted 55·0 ppm of phosphamidon succumbed to 18·0 ppm of DDVP. Since the toxicity of DDVP to more economic species such as *L. fimbriatus*, *C. mrigala* and *C. carpio* is lower, there is scope for the use of DDVP as a selective fish toxicant. This is confirmed by other workers[15] also. It can also be used to eliminate frog tadpoles from fish nurseries.

Meyer[11] and Henderson et al.[12] thought that malathion could be used as selective fish toxicant. Our data indicate that malathion is not suitable for this role but that DDVP would be a useful selective fish toxicant. The toxicity of metasystox was high to the Bangkok strain of common carp but less for other species. 300 ppm of $CaCl_2$ (hardness of the medium 238 ppm) did not reduce the toxicity of metasystox or of parathion to fish. A slight increase in mortality was noted. 300 ppm of $MgSO_4$ (hardness 190 ppm) also did not reduce the toxicity of parathion. pH value upto 9·0 also did not influence the toxicity. Henderson and Pickering[14] also noted that hard water did not reduce the toxicity of parathion or malathion to fish.

In view of the fact that these organophosphorous insecticides are easily and rapidly decomposed in water[10-14] (Holden, 1963), they could be used for the eradication of unwanted fish from ponds and lakes.

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LETTERS TO THE EDITOR

EMISSION SPECTRA OF *o-, m-,* AND *p*-FLUOROBENZALDEHYDES

THE electronic absorption spectra of benzaldehyde and its derivatives have been studied by several workers. Fluorobenzaldehydes,[1] like benzaldehyde, also have three regions of absorption, first near 2600 Å, second near 2900 Å and the third round about 3700 Å. The first two systems arise from π–π^* transitions and the last one by localised n–π^* transition in the carbonyl group. Though the absorption spectra due to n-π^* transition have been extensively studied in benzaldehyde and its halogen derivatives, not much attention has been given to the study of their emission spectra except benzaldehyde.[2,3] Recently the emission spectra of isomeric chlorobenzaldehydes have been reported by Juyal[4] and Singh and Juyal.[5] The present note reports the emission spectra of the three isomeric fluorobenzaldehydes in vapour state. A detailed study of their absorption spectra has also been made of which the emission spectra are counterpart. The spectra were photographed on a Q-24 Zeiss Medium Quartz and Fuess glass spectrographs and the results are given below.

o-Fluorobenzaldehyde.—The spectrum lies in the region 3750–5600 Å. About 140 bands all degraded to red have been measured. Some of the bands are diffuse and broad while others are quite sharp. The 0–0 band appears at 26336 cm.$^{-1}$ which has also been measured in absorption at the same place. A band at a separation of 1733 cm.$^{-1}$ from the 0–0 band is found to be the most intense one and is assigned as the C=O stretching frequency in the ground state. This frequency forms a long progression and its four overtones have been observed. This frequency and its overtones combine frequently with other fundamental frequencies.

m-Fluorobenzaldehyde.—The bands lie in the region 3650–5575 Å and 135 bands have been obtained. The 0–0 band has been measured at 26739 cm.$^{-1}$ The C=O stretching frequency in this case is 1745 cm.$^{-1}$ and five overtones of this have been recorded. This also combines with almost all other frequencies in the ground state.

p-Fluorobenzaldehyde.—The 0–0 band has been identified at 27229 cm.$^{-1}$ In this case most of the bands are sharp. The frequency

1731 cm.$^{-1}$ is found to be the most prominent one which forms long progression. This along with its five overtones combines with other ground-state frequencies and enables the interpretation of other bands.

The electronic excitation energy involved in this system of fluorobenzaldehydes is in the order $o < m < p$ which is the same as in chloro and bromobenzaldehydes.

The other fundamental frequencies in the ground and excited states of the three compounds are presented in Table I.

TABLE I

Compound	Ground-state frequency in vapour (cm.$^{-1}$)	Excited state frequency in vapour (cm.$^{-1}$)
Ortho fluoro-benzaldehyde	185, 271, 409, 510, 754, 804, 845, 1003, 1031 1145, 1185 1230, 1280, 1360, 1480, 1582, 1610, 1733	190, 332
Meta-fluoro-benzaldehyde	186, 230, 277, 406, 452, 518, 778, 1008, 1040, 1130, 1265, 1314, 1392, 1560, 1609, 1745	155, 266, 345, 476, 610
Para-fluoro-benzaldehyde	205, 305, 340, 428, 713 840, 861, 1020, 1035, 1151, 1218, 1320, 1390, 1570, 1595, 1730	218, 323, 359, 528, 653

Dept. of Spectroscopy,   M. P. SRIVASTAVA.
Banaras Hindu University,   I. S. SINGH.
Varanasi-5, *May* 8, 1967.

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THE EMISSION SPECTRUM OF BERYLLIUM BROMIDE

A CHARACTERISTIC blue colour was emitted when a mixture of Argon and Bromine, passed over warm Beryllium metal powder placed in a continuously evacuated quartz tube, was excited in a high frequency (30 Mcps.) discharge, from a 1/2 kw. oscillator. This characteristic blue colour when photographed on a Hilger Quartz Littrow spectrograph, revealed the existence of

a doublet system of red degraded bands, in the region λ 3650–3900 Å, attributable to the diatomic BeBr molecule. This system is analogous to the well-known $^2\pi$-$^2\Sigma$ system of BeCl, in the region λ 3450–3700 Å. The R_2, R_1 and Q_1 heads of the system could be represented by the following vibrational quantum formulæ to within an accuracy of about 3 cm.$^{-1}$:

$$\nu_{R_2} = 26558 \cdot 3 + 694 \cdot 5 \ (v' + 1/2)$$
$$- 4 \cdot 0 \ (v' + 1/2)^2 - 715 \cdot 2 \ (v'' + 1/2)$$
$$+ 5 \cdot 2 \ (v'' + 1/2)^2 - 2 \cdot 5 \ (v' + 1/2) \ (v'' + 1/2).$$

$$\nu_{R_1} = 26401 \cdot 85 + 686 \cdot 4 \ (v' + 1/2)$$
$$- 2 \cdot 25 \ (v' + 1/2)^2 - 703 \cdot 5 \ (v'' + 1/2)$$
$$+ 4 \cdot 25 \ (v'' + 1/2)^2 - 2 \cdot 4 \ (v' + 1/2) \ (v'' + 1/2)$$

$$\nu_{Q_1} = 26357 \cdot 2 + 701 \cdot 2 \ (v' + 1/2)$$
$$- 4 \cdot 5 \ (v' + 1/2)^2 - 713 \cdot 8 \ (v'' + 1/2)$$
$$+ 3 \cdot 5 \ (v'' + 1/2)^2.$$

A full discussion will be published shortly.

Spectroscopy Labs.,   Y. Prabhakara Reddy.
Andhra University,   P. Tiruvenganna Rao.
Waltair, *May* 23, 1967.

OPTICAL MICROSCOPIC STUDY OF THE CYLINDRICAL SURFACES OF THE MELT-GROWN CADMIUM SINGLE CRYSTALS

In this report, some interesting features observed on the cylindrical surfaces of the melt-grown single crystals of cadmium are presented and discussed. Careful optical microscopic examination of the cylindrical surfaces of the melt-grown cadmium single crystals has revealed the presence of regularly arranged pits of various shapes aligned along the axis of the cylindrical crystal. Figures 1-3 are the micrographs showing a variety of pits observed on the as-grown cylindrical surface of a cadmium single crystal. Figure 1 is a profile micrograph showing hexagonal pits while Figs. 2 and 3 show rectangular and triangular pits respectively.

The observed variation in the shape of the pits around the cylindrical surface was found to be quite systematic and regular. The orderly variation in the shape of these pits was studied

1-4. Fig. 1. Profile micrograph showing hexagonal pits, × 580. Fig. 2. Profile micrograph [rec]tangular pits, × 580. Fig. 3. Micrograph showing triangular pits, × 580. Fig. 4. Photomicro-[graph show]ing spiral pit on a hopper type crystal face observed on the cylindrical surface of a melt-grown × 3,200.

by mounting a crystal horizontally on a Wollaston's Goniometer. The crystal mounted horizontally on the Goniometer was later examined under a metallurgical type optical microscope. The crystal under the microscope was so adjusted that the direction of observation was perpendicular to the basal surface of the hexagonal pits (Fig. 1). Then the crystal was rotated around its axis till the rectangular pits could be seen through the microscope. The angle through which the crystal was required to be rotated from its initial position to bring the rectangular pits in the field of view was fairly close to 90° (Fig. 2). Half-hexagonal pits also could be seen on rotating the crystal through nearly 45° from the initial position. The pits triangular in shape could be seen when the crystal was rotated through nearly 60° from its initial position (Fig. 3). This kind of systematic angular distribution of the pits around the cylindrical surface led the author to think that the various shapes of the pits observed were nothing but the projections of the hexagonal plane at different angles. Light profile examination of these pits shows the pit depths to be of the order of a few microns. The results further suggest that these pits are produced due to evaporation from the surface possibly at the sites of dislocations.

In quite a few cases, the examination of these cylindrical surfaces has exhibited growth features analogous to the hopper growth. Figure 4 is one such photomicrograph showing a hopper type crystal face on the cylindrical surface of a melt-grown cadmium single crystal. A spiral pit can be seen on this particular hopper face. Amelinckx[1] has observed hopper crystal faces on Salol and Thymol. Hopper growth has also been demonstrated in Bismuth[2] by the observation of {100} hopper faces obtained by decanting. During the solidification from the melt, the insoluble impurities present inside the bulk continually diffuse towards the outer cylindrical surface and consequently build up an impurity concentration gradient in a transverse direction. This sort of segregation of the impurities produces supercooling in the melt. The resulting supercooling in the melt is believed to be responsible for the type of hopper growth observed by the author in the melt-grown cadmium single crystal.

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SYNTHESIS OF 7-AMINO FLAVONES AS POTENTIAL BACTERICIDES

BAPAT AND VENKATARAMAN[1] synthesised 7-aminoflavones regarding them as derivatives of 4-amino salicylic acid and reported that 7-aminoflavone inhibits the growth of Mycobacterium tuberculosis. Kidd[2] reported the synthesis of 7-amino-4'-methoxy flavone from 2-hydroxy-4-nitroacetophenone by this method. But the experimental details were not given. The synthesis of these compounds has been undertaken with a view to evaluate their physiological activity.

Adopting the simplified Baker-Venkataraman method a number of 7-aminoflavones have now been synthesised by condensing 2-hydroxy-4-acetamino acetophenone and 2-hydroxy-4-acetamino propiophenone with benzoyl chloride, anisic anhydride, veratroyl chloride, and trimethyl galloyl chloride and potassium carbonate in acetone. It is observed that in the case of simple acetophenone, β-diketones (I) are formed which could be cyclised to the corresponding acetamino flavones (II), whereas in the case of ω-substituted acetophenones, corresponding acetaminoflavones (II) formed directly. The acetaminoflavones have been later deacylated using methanolic hydrochloric acid to the corresponding aminoflavones. The compounds synthesised are listed in Table I.

The aminoflavones synthesised were tested for their activity against *Bacillus subtilis*, *Bacillus coli*, *Staphylococcus aureus* in 10,000 dilution. 7-Aminoflavone, 3', 4'-dimethoxy-7-aminoflavone, and 3', 4', 5'-trimethoxy-7-aminoflavone were found to be active.

TABLE I

Sl. No.	Compound	mp.° C.	Calculated			Found		
			C	H	N	C	H	N
1	4'-Methoxy-7-aminoflavone ..	195	71·9	4·8	5·2	71·8	4·4	5·3
2	2-Hydroxy-4-acetamino-ω-veratroyl acetophenone	196	63·9	5·3	3·9	63·9	5·3	4·1
3	3', 4'-Dimethoxy-7-aminoflavone ..	222	68·7	5·0	4·7	68·9	5·5	5·0
4	2-Hydroxy-4-acetamino-ω-galloyl acetophenone ..	196	62·0	5·4	3·6	62·3	5·6	3·9
5	3', 4', 5'-Trimethoxy-7-aminoflavone ..	272	66·0	5·1	4·2	66·3	5·3	4·5
6	3-Methyl-7-acetaminoflavone	279	73·7	5·1	4·8	73·8	5·3	4·6
7	3-Methyl-7-aminoflavone	211	76·5	5·4	5·5	76·5	5·8	6·1
8	3', 4'-Dimethoxy-3-methyl-7-acetaminoflavone ..	221	68·0	5·4	4·0	67·9	5·3	4·2
9	3', 4'-Dimethoxy-3-methyl-7-aminoflavone ..	232	69·5	5·43	4·5	69·7	5·6	4·4
10	3', 4', 5'-Trimethoxy-3-methyl-7-acetaminoflavone	241	65·8	5·5	3·7	65·9	5·0	3·7
11	3', 4', 5'-Trimethoxy-3-methyl-7-aminoflavone ..	215	67·1	5·6	4·1	67·0	5·1	4·5

Dept. of Chem.,   (MISS) M. VIJAYA LAKSHMI.
Osmania Univ.,   N. V. SUBBA RAO.
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COMPOSITION OF THALLOUS-PHENOLSULPHONATE COMPLEX

SOME complexes of thallium (I) with aromatic acids have been studied by Sahu *et al.*[1-3] but thallous-phenolsulphonate complex has not been cited in the literature up to date. We have therefore taken up the present investigation by measuring the resistance of the solution.

E. Merck sample of thallous nitrate and B.D.H. make sodium salt of phenolsulphonic acid (Na-PSA) were used. Preparation of all solutions and their dilution were done with double distilled water. For resistance measurement RADART R.C. Bridge type 432 A and dip type conductivity cell were used. All measurements were done at a temperature of 28° C.

The composition was first studied by mono-variation[4] method. M/50 and M/100 equimolar solutions were used. The volume of thallous nitrate solution was kept constant to 10 ml. and total volume maintained at 40 ml. Observed resistances plotted against the volumes of added Na-PSA gave well-defined breaks for 10 ml. of the ligand showing 1 : 1 composition of the complex.

The composition was further confirmed by Job's[5] continued variation method. M/100 and M/125 equimolar solutions were mixed. Metal and ligand solutions were mixed ranging from 100% metal and 0% ligand to 0% metal and 100% ligand. In both the cases graph for the observed resistance against the per cent of ligand gave minima at 50% each of the metal and ligand solution confirming 1 : 1 composition of the complex.

The 1 : 1 composition was again confirmed by titrating the complex with sodium hydroxide. M/50 equimolar metal and ligand solutions were mixed in 1 : 1, 1 : 2 and 1 : 3 ratios. Various samples of these mixtures, after the attainment of equilibrium, were titrated with M/50 sodium hydroxide. In all the three cases only one significant break was obtained (Fig. 1), corresponding to one equivalent of the alkali. As

FIG. 1.   A = 1 : 1,   B = 1 : 2, C = 1 : 3 mixtures of metal and ligand, titrated with M/50 NaOH.

there is only one replaceable hydrogen atom in the ligand, the break at one equivalence of alkali suggests 1 : 1 complex in the system.

Chemical Laboratory,   G. L. AGRAWAL.
Birla Institute of Tech.,   K. N. SAHU.
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ISOVITEXIN FROM THE SEEDS OF *CROTALARIA ANAGYROIDES*

VERY recently Bhatia and Seshadri[1] have reviewed the distribution of C-glycosides occurring in nature, their special structures and biogenesis. According to Wagner,[2] about thirty different plant sources for flavonoid C-glycosides are so far known and these compounds are found in all parts of plants (there is no mention of seeds). In continuation of our earlier work[3] on the isolation of orientin and iso-orientin from the seeds of *Crotalaria laburnifolia* we give below in brief the results of our study of the seeds of *Crotalaria anagyroides* H. B. and K. (Family: Leguminosæ) for flavonoid compounds.

Fresh mature seeds of *C. anagyroides* growing in Pondicherry were crushed in a glass pestle and mortar and extracted four times with hot ethanol (80%) under reflux and the total extract concentrated *in vacuo* till all the alcohol was removed. The aqueous concentrate was repeatedly shaken with light petroleum, ether, ethyl acetate and methyl ethyl ketone in succession. The fatty matter and lipoid pigments (carotenoid and chlorophyll) were all removed by light petroleum and ether, and the subsequent ethyl acetate and methyl ethyl ketone layers contained flavonoid glycosides. The yellow solid residue from the ethyl acetate extract was crystallized twice from hot methanol, when yellow needles melting at 230-32° were obtained; yield 0·5% on fresh weight basis. It gave all the tests for flavonoid glycosides, but could not be hydrolysed with 7% sulphuric acid (aqueous alcoholic medium) in 8 hours or with 25% hydrochloric acid in 2 hours, indicating that the pigment was not an O-glycoside. On treatment with hydriodic acid in phenol, a yellow product not melting below 300° was obtained. This aglucone was identified as apigenin by its typical colour reactions and paper chromatography

in different solvent systems,[4,5] and through its acetate, m.p. 181–82°. Direct comparison was also made with an authentic sample of the compound.

The glycoside, m.p. 230–32°, was identified as isovitexin, 6-c-glucosyl apigenin by means of typical colour reactions, behaviour under ultraviolet light, paper (circular and ascending) chromatography in different solvent systems.[4-6] The identity was confirmed by direct comparison with an authentic sample of the compound.

The residue from the methyl ethyl ketone layer was also not hydrolysable with mineral acid indicating thereby that it was another C-glycoside. No crystalline pigment could be isolated, but the presence of vitexin, 8-c-glucosyl apigenin was established by colour reactions, and paper chromatography in different solvent systems[4-6] and comparison with an authentic sample of the compound.

It may be mentioned here that this is the first report regarding the isolation of isovitexin from the seeds of *C. anagyroides*. It is also interesting that the yield of the glycoflavonoid is the highest reported so far from any plant source.

We thank Prof. T. R. Seshadri and Prof. L. Hörhammer for their kind interest in this work, Dr. M. K. Seikel for authentic samples of isovitexin and vitexin, and Principal Dr. D. J. Reddy for encouragement.

Jawaharlal Inst. of   S. SANKARA SUBRAMANIAN.
Post-graduate   S. NAGARAJAN.
Medical Education and Research,
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DETECTION OF RUBBERSEED OIL IN EDIBLE OILS BY PAPER CHROMATOGRAPHY

THE seeds of the rubber tree, *Hevea brasiliensis*, yield a semi-drying oil which is reported to have come into use recently as an adulterant of edible oils. The analytical characteristics of the oil (Table I) do not differ sufficiently from those of the common edible oils to enable the

TABLE I

Characteristics of rubberseed oil and some edible oils

Oil characteristics	Gingelly oil	Groundnut oil	Safflower oil	Rubberseed oil
Analytical :				
Reference	1	1	1	*
Butyro-refractometer reading at 4(° C	58·0–61·0	54·0–57·1	62·4–64·7	62·0
Saponification value	188–193	188–196	186–196	190
Iodine value	105–115	85–99	135–146	136
Free fatty acids (as oleic acid%)	Not more than 3·0	Not more than 3·0	Not more than 3·0	9·7
Turbidity temperature	Not more than 22° C.	39°–41° C.	Not more than 16·0° C.	24° C.
Unsaturated fatty acid composition :				
Reference	2	3	4	5
Oleic	35·0	52·5	14·7–17·3	17
Linoleic	48·6	26·3	76·6–79·0	35
Linolenic			0·04–0·13	24

* Values given by a sample of oil prepared in the laboratory.

detection of 10 to 15% of the oil in admixture with other oils.

FIG. 1. Chromatograms of the unsaturated acids of common vegetable oils and rubberseed oil. (1) Sesame, Groundnut, Cottonseed, Safflower, Coconut and Mahua oils. (2) Nigerseed oil. (3) Rubberseed oil. (4) Mixture of sesame and rubberseed oil (95 : 5). (5) Mustard oil.

Although rubberseeds contain a cyanogenetic glycoside the oil itself is free from the glycoside and from hydrogen cyanide. Rubberseed oil contains a large percentage of linolenic acid whereas the common edible oils contain practically no linolenic acid.

We have found that the separation of the linolenic acid present in the oil by reverse phase chromatography enables its detection in other oils in concentrations as low as 5%. The total fatty acids are prepared as in the titre test and spotted on Whatman No. 4 paper impregnated with medicinal liquid paraffin by dipping in a 10% solution in ether. The chromatogram is developed in acetic acid-water-amyl acetate (6 : 2 : 2) saturated with liquid paraffin by the ascending technique for 16 hours.[6] The unsaturated acids are identified by means of iodine vapour.

A few typical chromatograms are illustrated in Fig. 1. Two spots with R_f values, 0·38 and 0·46, due to oleic and linoleic acids, are obtained with gingelly oil, groundnut oil, safflower oil and many other oils. Rubberseed oil gives rise, in addition to these two, to a spot with an R_f value of 0·54, due to linolenic acid. The only interference is from linseed oil and mustard oil. Linseed oil is not an edible oil; its high refractive index and iodine value are highly characteristic. Mustard oil is distinguished from all other oils by the spot due to erucic acid, R_f value 0·14.

Our thanks are due to Sri. K. Narayanaswamy, Government Analyst, for having provided facilities for this study.

Government Analyst's   P. S. NATARAJA SARMA.
   Laboratory,   G. BALASUBRAHMANYAM.
Madras, *February* 13, 1967.

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BASAL METABOLIC RATE (BMR) IN ASCORBIC ACID DEFICIENT GUINEA PIGS

IT has been previously reported[1] that growth failure in ascorbic acid deficiency can be attributed to (a) lowered food intake and (b) inefficient utilization of protein. It was also considered possible that altered energy metabolism could be an additional factor for the lowered growth rate. Studies on basal metabolism were therefore carried out in ascorbic acid deficient guinea pigs and the effect of an antithyroid drug on BMR and growth investigated.

Chronic hypovitaminosis C was produced in young male guinea pigs. The diet and experimental conditions were as previously described,[1] except that the deficient animals received 0·2 mg. ascorbic acid/day instead of 0·4 mg./day. Basal metabolic rate was determined in all the animals 30 days after the experimental diet was instituted, by which time, the deficient animals were losing weight. A week later, when the loss in body weight had become considerable, thiouracil an antithyroid drug was incorporated into diet (200 mg./100 g. diet). Ten days after maintaining the animals on the diet containing thiouracil, BMR was redetermined.

Oxygen uptake was measured by the use of a volume meter (Model 160, Med. Science Electronics, Inc., St Louis, Mo, U.S.A.) which is capable of measuring accurately, extremely small volumes in a closed system and allows simultaneous measurements of oxygen consumed and carbon dioxide exhaled by the animal, making the determination of respiratory quotient (RQ) possible. The metabolic rate was calculated as $C/m.^2/24$ hrs. using the formula described by Kibler *et al.*[2]—surface area $= 9·85\,W^{0.64}$.

The animals maintained on low intakes of the vitamin grew satisfactorily only for the first three weeks and started to lose body weight at a considerable rate, thereafter (Fig. 1). At this point of time their BMR as compared to the control and the pair-fed animals was markedly elevated. The subsequent administration of thiouracil was associated with a fall (18%) in the BMR in the deficient animals (Table I) and a simultaneous increase in body weight. The RQ of all animals were essentially similar. Beaton *et al.*[3] have also reported an increased consumption of oxygen in scorbutic guinea pigs and have suggested that this is mediated through altered thyroid functions. Mosonyi

and Kezdi[4] have demonstrated that in scorbutic and thyroidectomized guinea pigs, the increase in oxygen consumption was less marked than in animals with the gland intact.

FIG. 1

TABLE I

Basal metabolic rate in ascorbic acid deficient guinea pigs ($C/m.^2/24$ hours)

Sl. No.	Before Thiouracil			After Thiouracil		
	Deficient	Pair-fed	Control	Deficient	Pair-fed	Control
1	542·2	501·5	490·0	408·6	481·9	538·2
2	521·0	455·6	461·9	388·2	506·6	518·1
3	454·8	361·6	434·6	Died	..	..
4	557·6	371·1	529·6	488·3	398·6	580·9
5	558·3*	429·1*	..	Died	..	..
6	726·1*	386·3*	..	,,	..	..
Mean	518·9	422·4	479·0	427·7	462·4	545·7

* These values were not included for calculating means.

The results obtained in this study confirm earlier reports that BMR is elevated in animals made ascorbic acid deficient. The gain in body weight following the administration of thiouracil in the deficient guinea pigs, but not in the controls, suggest that increased rate of basal energy expenditure, is a contributory factor in the lowered growth rate seen in chronic ascorbic acid deficiency.

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LABORATORY BREEDING OF TWO RATS

DEORAS (1960) and Habbu (1960) have mentioned that *R. rattus*, the house-rat, was showing resistance to *P. pestis*. Such phenomenon of resistance has been seen by Seal (1960) and W.H.O. Chronicle (1966) has quoted that in the hinterland in some areas of Andhra Pradesh, Madras and Mysore states, *Bandicota bengalensis* and *Tatera indica* were seen to be very susceptible to *P. pestis*. In our collections of rats in the hinterland of Vidarbha and Marathwada regions the most predominant rat was *R. rattus* and this was showing a varying amount of resistance to *P. pestis*.

The question was, whether this resistance was due to some recently acquired immunity or was genetic. The problem in the first instance therefore was to breed these rats and see if their progeny also showed tolerance.

Wild animals are difficult to breed. Apart from the Arid Zone Research Unit at Jodhpur, records are not there to indicate the continuous breeding of these rats in the laboratory, giving an account of the measurements of their younger stages. However attempts were made here to breed *R. rattus* and *T. indica*. This note is a summary of this breeding technique account only.

R. rattus collected from the town of Bombay were held for one month, and paired in deep tin cages. *T. indica* had been collected from the hinterland in the Vidarbha region. They were paired in cages in the laboratory. In the first delivery in the cages the females in both the rats ate the young, when disturbed, but later they got acclimatised and bred. Fifteen pairs of *R. rattus* were kept, of which only seven have bred upto F_1 generation. In the case of *Tatera indica* there have been five generations bred so far in the laboratory. The point of interest in this rat was that the gestation period gradually got reduced from 34 to 22 days when the same pair was kept for a continuous breeding. Changing of the male alone increased the gestation period to 41 days. The breeding is still continuing.

The cage used here was 10 inches wide, 11 inches deep and $16\frac{1}{2}$ inches long with $4'' \times 8''$ spaces on the wide upper side and the top, being covered by a 18-mesh wire-gauze. The cage contained a 4-inch high tray with a perforated bottom for liquids to go down. The tray could be lifted and then the removable top formed a lid to it. The rats could thus be kept in the tray, the cage cleaned and routine

handling eliminated. Paper cuttings were given as bedding. Water-bottles with a spout jetting inside the cage was kept for drinking.

Food consisted of cubes made of the following material: wheat bran-180 gm.; mixed cereals [consisting of 50% jowar (*Andropogon sorgham*) and 50% gram (*Cicer arientum*)] 180 gm.; dried crushed lucerne-15 gm.; Linseed oilseeds-50 gm.; dried powdered meat-20 gm.; casein-20 gm.; fish-oil-50 gm.; yeast powder-20 gm.; milk powder-20 gm.; sodium chloride-2·5 gm.; calcium carbonate-2·5 gm.; vitamin C-2 gm.; Nicotinic acid-7·5 gm.; and vitamin B and B_2-1 gm. each. All this was mixed, made into cubes and dried at 120° C.; before being used.

Figure 1 and Table I give the indication of gestation period in these two rats, and the

		Av. wt. gms.			Av.: 7 pairs	Litter size (Nos.)			Gestation
Species	Sex	Max.	Min.	Av.		Max.	Min.	Av.	Days
R.rattus	♂	170	85	122	} 6		4	4·9	47·0
" "	♀	122	65	92·5					
T. indica	♂	185	114	162	} 6		3	4·5	39·5
" "	♀	150	120	140					

TABLE I and FIG. 1. Showing the weight measurements n growth of *R. rattus* and *T. indica*.

weights of young ones in different periods of development. From the above graph it will be noticed that though initially both the species started with the same weight on the first day, an increase came in one, and stabilisation in the other. Young of both at birth were hairless and darker dorsally. In *R. rattus*, the fur starts coming on the 5th day, ears open on 11th day and eyes open on the 14th day. In the case of *T. indica* the first coat of fur comes on 10th day, ears open on 8th day and eyes open on 20th day. The testes descended into the scrotum in *R. rattus* by 51 days and in *T. indica* by 75th day.

The breeding in *T. indica* is continuing, as these animals seem now to breed continuously in the laboratory.

We are thankful to the Indian Council of Medical Research for the financial support and grateful to Messrs. Shah, Chaturavedi, Vad and Masurekar for help rendered in these experiments and to the Director, Haffkine Institute, for the facilities.

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THE PENETRATION GLAND IN THE MIRACIDIUM OF THE STRIGEID, *PROALARIOIDES TROPIDONOTIS* (VIDYARTHI, 1937)

IN the miracidia of Digenea there is a median anterior structure filled with a secretory product. It has been variously designated as primitive gut, rudimentary gut, or elementary digestive system. At a cursory glance it presents a sac-like appearance and this perhaps has been the cause for the notion that it may be a gut or something allied to it. But in many miracidia subjected to more critical examination it is always seen to contain a characteristic secretion and far from being a gut it displays the features of a gland. Dawes[1,2] from a study including sectioned material of snail tissues containing recently penetrated miracidia of *Fasciola hepatica* L. and *F. gigantica* Cobbold, concluded that it is a gut although he recognised it to be syncytial. In the present investigations on the miracidium of the strigeid *Proalarioides tropidonotis* from the intestine of the water-snake *Tropidonotus piscator* (Wall) it has been possible to take a careful look at this gland both in live material and selectively stained sections.

In this miracidium, in the living condition the gland is usually long, extending very much into the posterior region. Frequently it can be seen to comprise of a bulbous anterior part connected to a similar wider posterior portion by a relatively narrow isthmus (Fig. 1). It is filled with a secretion which includes many minute granules in Brownian movement. At the anterior end it almost fills the space in the semi-globular terebratorium which bears numerous minute pores through which the secretion is presumably let out. Such a condition has been reported by Hugghins[3] in the miracidium of *Hysteromorpha triloba* (Rudolphi, 1819) Lutz, 1931, which is also a strigeid. The gland contains four vesicular nuclei with prominent nucleoli and the entire structure has the general appearance of a syncytium, no cell boundaries having been noted. The secretion which completely fills the gland exhibits an intense PAS positive reaction which remains unaffected even after digestion with saliva. When the Azan technique is employed, the gland material takes a brilliant blue colour that appears vividly in sections. With Sudan Black B the gland is unstained, the granules remaining yellowish. Apart from this single conspicuous gland no other glandular structures are revealed by these staining reactions in the miracidium. From the nature of the staining reactions mentioned above, this gland is comparable to the 'postacetabular secretory apparatus' studied by Stirewalt and Kruidenier[4] in the cercariæ of *S. mansoni*. These postacetabular glands have been revealed dramatically and superbly by the above authors in the colour photographs of the cercariæ prepared after the application of the PAS or Mallory's triple staining techniques. They have suggested that

FIG. 1. Miracidium of *Proalarioides tropidonotis* showing penetration gland. E, Eye spot; LP, Lateral papilla; N, Nuclei of penetration gland; P, Pores; T, Terebratorium.

'the mucoid postacetabular secretion serves adhesive, lubricative, protective and enzyme-directive functions.' The presence of a PAS positive secretion (in the penetration glands) which causes erosion of the cells of digestive canal during the penetrating activities of the oncosphere has been indicated in some cestodes.[5]

There is thus abundant evidence to suggest that the median anterior structure filled with a secretion in the miracidium of *P. tropidonotis* or for that matter in other miracidia is actually a gland and not a gut. The copious secretion stored in it may be implicated mainly in the process of histolysis of the snail tissue to facilitate penetration of the larva. It would appear that in most respects the nature of its secretion resembles that of the postacetabular glands in the cercaria of *S. mansoni*. In the sporocyst stage there is no trace of this gland, just as in the schistosmulæ the postacetabular glands disappear. In the final analysis the situation seems to correspond to a holocrine type of secretion involving the entire gland. Wajdi[6] in a recent study on the miracidium of *S. mansoni* suggested that it would be proper to call it a penetration gland. He also mentioned that the gland appeared deep blue in material subjected to Mallory's triple staining procedure. Manter[7] discussed the character of this gland with particular reference to the miracidium of *Otodistomum cestoides* (van Ben.). He has succinctly shown that this 'four-nucleate' organ shows neither a cellular wall nor a lumen and furnished evidence against its interpretation as a gut. In the light of these facts the claim of Dawes that in the miracidia he studied, this structure represents a gut cannot be sustained.

We are grateful to Prof. P. N. Ganapati for encouragement and interest.

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THE DISK OF ECHENEID FISHES

A NEW orientation in the study of Echeneid Fishes was started in 1961[1] and followed up in 1962,[2] 1964[3] and 1966.[4,4a] The latest account emphasized that adhesion is only a secondary function and described the neural arch as consisting of two chambers separated by a transverse partition and that the fluid in the upper chamber can move forward and supply the requirements of the disk. It was also shown that every movement of the plates of the disk can be conveyed to the spinal cord direct.

The L.S. of the anterior portion of Echeneis (Fig. 1) reveals that the upper surface of the cranium is curved with a raised supra-occipital, a sloping fronto-parietal and a nasal with a depression on it. Just in front of the nasal there is a cartilaginous movable body the rostral cartilage considered an ethmoid, which has a curved anterior border and a straight posterior one better seen in Fig. 2. This bit of cartilage is closely invested with a covering which is attached by connective tissue to the movable premaxillæ and at the sides to the two pairs of supramaxillæ.

When the premaxillæ are lowered the front margin of the rostral cartilage will be drawn down and the hind region raised. The lowering of it is brought about mainly by the contraction of the tissues attached to the first and second pairs of supramaxillæ. By these alternate movements a valvular action is produced which can have important results.

Five possibilities suggest themselves :

(1) It might be that the depth of the depression on the nasal is increased with the result that the fluid now occupies the fronto-parietal region as well, and if the quantity of fluid is still further raised by fluid from the supra-neural channel when the fish attaches itself to a surface, the level can rise till the supra-occipital height is reached. Figures 1 and 3 are intended to illustrate these by the various degrees of shading. (2) If the pressure thus produced increases beyond limits the rostral cartilage possibly acts as a safety valve allowing a part of the fluid to run elsewhere as for instance into the mouth. (3) It might be that the valve diverts fluid up into the disk increasing its adhesive pressure. (4) Other organs in the front end of the disk such as blood sinuses, coeomic spaces, muscles, etc., might be alternately pressed upon regulating their functions (*vide* Fig. 4). (5) Lastly a cross-section made in the front region shows that the lateral line canals are in close proximity to the rostral

cartilage that it cannot but affect their fluid contents communicating every vibration to them. One or more of these functions might be performed simultaneously.

respectively at frequencies determined by a continuous process of the receptors.

Sand[7] confirms that the lateral line system is exceedingly sensitive to low frequency

L.S OF ANTERIOR PORTION OF ECHENEIS
(DIAGRAMMATIC)

ROSTRAL CARTILAGE IN FRONT END OF SKULL

DORSAL VIEW OF ANTERIOR PORTION

OF ECHENEIS WITH DISC REMOVED

FIGS. 1–4. Fig. 1. L.S. of anterior portion of Echeneis (Diagrammatic). AC., Alimentary canal; BA, Basiarch; BC, Brain case; BP, Basal plate; BS, Basistrut; CBB, Canal below basistrut; COC, Canal over cranium; DOS, Depression on skull; L, Lamella; LB, Lamellobasal; LJ, Lower jaw; Py, Pyriboss; RC, Rostral Cartilage; S I, Subtactilodact; T, Tactilodact; V, Vertebra; 1, 2, 3, steps bounding the cavity at three levels. Fig. 2. Rostral cartilage in front end of skull. D, Dentary; M, Maxilla; PM, Premaxilla; RC, Rostral cartilage; SM I, Supra-maxilla I; SM II, Supramaxilla II; T_1, Tendon 1; T_2, Tendon 2. Note especially the shape of the rostal cartilage. Fig. 3 Dorsal view of anterior portion of Echeneis with disk removed. DLM 1, Dorsal longitudinal muscle 1; DLM 2, Dorsal longitudinal muscle 2; E, Epiotic; FP, Frontoparietal; LJ, Lower jaw; N, Nasal; PP, Postparietal; RC, Rostral cartilage; SC, Supra-cleithrum; SO, Supra occipital; UJ, Upper jaw; 1, 2, 3, steps indicating the front margin at three levels. Note also the rounded front margin and straight posterior border of the rostral cartilage. Fig. 4. Cross section of the front end of the upper jaw of Echeneis. BSI, Blood sinus; DOS, Depression on skull; LLC, Lateral line canal; M, Muscle; PM, Premaxilla; PU, Pulvinus; RC, Rostral cartilage; S, Space; SS, Sensory surface; TO, Tooth; V, Vomer.

Parker[6] has shown that water vibrations of low frequency are perceived by the lateral line canals and the electrophysiological studies of Hoagland[5] speak of two kinds of receptors in the canals one directly responsible to tactile and pressure stimuli and compression from surrounding tissues and the other the continuously active function emitting impulses

vibrations, that responses to vibrations are modified or completely suppressed during an inhibitory perfusion of the canal and that direct mechanical stimulation of the lateral line as well as vibrations propagated from a distance are effective in exciting the receptors on account of the movements they cause in the endolymph of the canals.

The lymph circulating on the top of the skull and the endolymph of the lateral line canals possibly work in consonance and the rostral cartilage might be concerned with it. Feedback systems involving reverberating circuits are likely to be found if electrophysiological studies are undertaken.

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"Bonanza",
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ON THE OCCURRENCE OF SMALL-SIZED OIL SARDINE *SARDINELLA LONGICEPS* VAL.

THE occurrence on a large scale of small-sized oil sardine during the period 1960–66 is of special significance since the fishery, though known for its erratic nature and annual fluctuations, had become steadier during this period yielding an average annual catch of 135,252 tonnes forming 17·89% of the total marine fish landings in India. Not only has such occurrence of juveniles in the inshore waters served as an index of a successful oil sardine fishery, but it has also thrown useful light on certain vital aspects such as the spawning period and the size at which the new recruits and 1-year olds enter the fishery. A perusal of the literature revealed that such consistent occurrence of small-sized oil sardine has not been reported before.

In the course of investigations on the oil sardine fishery in the Mangalore zone, very young ones measuring 35 mm. onwards were observed to occur on a large scale in the months of July, August, September and October during the years 1960-66. These were caught exclusively by the non-selective gears, *viz.*, *Koori bale* (small meshed cast net), *Kairampani* (shore-seine) and *Kolli bale* (boat-seine) operated in the inshore waters ranging in depth from 1/2

to 6 metres. The occurrence of such very small-sized oil sardine in the shallow coastal waters suggests that the spawning grounds of this commercially important species, which are yet to be located, may not be far away.

The size frequencies of young ones of oil sardine during the July-October period (Fig. 1)

FIG. 1

clearly indicate that the juvenile population is constituted by more than one group. However, detailed analyses of the size composition of juveniles based on individual samples showed that there is no intermingling of different broods as evidenced by the unimodal nature of the size frequencies.

From Fig. 1 it is seen that in July the mode is at 102 mm. Of late, one school of thought has been inclined to believe that this group represents the 0-year class recruited during the

current year's spawning. However, since past studies[1-4] have shown that in oil sardine the spawning commences in June and not earlier and extends up to October or even beyond, it can be categorically stated that this group does not belong to the current year's spawning but comes from the product of the previous year. Similarly, distinct modes representing previous year's groups are seen at 92, 112 and 122 mm. in August, 102 mm. in September and 122, 117 and 122 mm. in October. In general, modes around 100 mm. seen from July to October during different years can be considered as those representing the products of late spawning of the previous year, which incidentally lends support to the view of a protracted spawning nature of the oil sardine. However, based on the assumption that the spawning period in oil sardine extends from June to November-December subject to slight variations depending upon the hydrological and ecological conditions, the modes at 47, 67, 77 and 82 mm. in August, 52 and 77 mm. in September and 92 mm. in October can be considered as those representing the products of the current year's spawning. From Fig. 1 it can also be seen that during October 1961 the modes are at 92 and 112 mm. and in August 1965 at 47 and 92 mm. thereby indicating that the fishery is supported by juveniles belonging to more than one "age class". While the size at which the 1-year olds enter the fishery during the commencement of the season in July is about 100 mm., the modal size of the 0-year class supporting the fishery during the months July to October appears to range from 47 to 92 mm.

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PROPAGATION OF STERILE MUTANTS AND HYBRIDS IN COTTON

DURING the course of cytogenetical and mutation work in cotton one comes across some interesting mutants or hybrids which because of sterility or altered photoperiodic requirements fail to reproduce. Such valuable mutants have been lost due to the incomplete success of alternate methods of propagation like grafting or by cuttings.[1] Vegetative propagation of cotton under Indian conditions is not unknown.[2,3] But these methods, under ideal temperature and humidity conditions, give only 50 to 70% success. When a single plant, which is abnormal, has to be propagated, complete success, even under sub-optimal conditions, is required.

In the summer season of 1966 two interesting plants were isolated in the field and both of them were sterile. One was an induced mutant of the variety H-14 (*Gossypium hirstum*) which in addition to many other morphological abnormalities of vegetative parts, had flowers with degenerated anthers even in the bud stage. On the female side also there was some sterility. The other plant was a suspected triploid (*G. hirsutum* $2n = 52 \times$ *G. raimondii* $2n = 26$). Under field conditions this plant failed to produce flowers because of unfavourable photoperiod (long days of summer). Otherwise, these two plants were vigorous with a well-developed root system and transplanting of such plant into pots was not possible.

With the idea of propagating these two sterile plants, air-layering (*gootee*) was attempted. Well-developed monopodial branches were selected and the outer bark in the form of a ring was removed at a convenient place. With a fine brush the upper part of the exposed portion was dusted with Seradix B-3 (M and B). Moist Sphagnum moss was used as the rooting medium and this was completely wrapped with alkathene film (of 200 guage) to prevent loss of moisture. Like this six to seven layers could be prepared in a single plant. This operation was done during September-October when the relative humidity was low and night temperature was also sub-optimal for rooting in cotton. After sixteen days, there was profuse development of roots which was visible through the alkathene film. Rooted branches were separated and carefully planted in pots and all the separated layers survived. The success of rooting was 100% in the case of H-14 and 75% in the triploid. It appears that this is a surer method than the ones previously employed.

Division of Genetics,   R. KRISHNASWAMI.
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EVOLUTION OF SHORT DURATION COTTON STRAINS (*G. HIRSUTUM*)

THE study of growth duration of cotton varieties needs particular attention in order to minimise the period of exposure of the crop to adverse weather conditions, pests and diseases. Most of our cotton varieties evolved in the country are considerably longer in duration, extending upto 8 or 9 months, thus leaving no scope for double cropping. With a view to evolving short duration varieties, research work was started in Uttar Pradesh as a result of which some of the promising short duration American cotton strains have been isolated. They are described below :

R.H. 11.—The strain was obtained from the cross M 4 × 036 and yielded about 10% higher than 320 F in *Tarai* tracts of Uttar Pradesh. The Bartlett's rate index of this strain is 0·74 as compared to 0·71 of variety 320 F. In staple length and ginning percentage it is at par with 320 F. Being an early maturing, this strain enables the farmer to take a wheat crop (K. 68 or N. P. 830) successfully.

H.S. 11.—This is a selection from R.H. 11, done at Hempur (Nainital) and possesses the ginning value of 36·1% as against 33·5% of R.H. 11. It matures by the first week of October thereby enabling to take up the cultivation of even cash crops like tobacco and potato.

Chief Cotton Res. Station,   HARI G. SINGH.
Uttar Pradesh,   S. K. GOVIL.
Bulandshar, *January* 2, 1967.   T. D. GUPTA.

THE STOMATA OF *TMESIPTERIS TANNENSIS* BERNH.

THE stomatal apparatus of members of the Psilotales has been studied by Sykes (1908), Zimmermann (1927), and Pant and Mehra (1963). However, there exists some controversy regarding the structure of the epidermis and distribution of the stomata in *Tmesipteris tannensis*. The present communication aims at dispelling this diversity.

The material employed for the investigation was collected by the late Professor P. Maheshwari from Australia during his visit to that country in 1965 and very kindly passed on to one of us (G. S. P.) for epidermal studies. The leaves were cleared by Foster's (1949) technique, stained with safranin dissolved in a mixture of xylol and absolute alcohol (1 : 1), and mounted in canada balsam.

The plant of *Tmesipteris tannensis* comprises an aerial stem and a subterranean rhizome. The former bears spirally-arranged leaves in 2 to 5 rows. The leaves are vertically placed, and vary in size from 2 to 2·5 cm. As would be clear from Fig. 1 A, they are sessile and possess an ovate to lanceolate outline, with a markedly mucronate tip (Fig. 1 B).

FG. 1. *Tmesipteris tannensis*. A. Portion of an aerial shoot showing arrangement of leaves, × ·75. B. A cleared leaf to show the distribution of stomata on the leaf blade. Note that the vascular supply ends much below the mucronate tip, × 5. C. Portion of epidermal peal showing orientation of stomata sinuous cellwalls, and cuticular thickenings, × 95. D. An epidermal cell (from upper epidermis) magnified to show arrangement of the cuticular striations, × 235. E. Single stoma, × 205. F. V.s. stoma, × 205.

A single vascular bundle runs in an almost vertical direction through the centre of the leaf lamina and terminates a little short of the tip. The cells comprising the mesophyll are curiously lobed. In a mature leaf the epidermal cells are conspicuously large. Their walls exhibit marked sinuousities and a thick cuticle laid up in definite striations. In a cleared leaf, stained with safranin, these striations appear as white streaks while the areas in between take a pinkish-red stain. Not all the bands on the epidermal cells are complete, *i.e.*, they do not traverse the cell cavity from one wall to the other (Fig. 1 D). The description and illustration given by Sykes (1908) for the epidermis do not appear to be quite correct. She writes that the ordinary leaf of *T. tannensis* has

stomata only on the adaxial side but we are unable to confirm this finding. Contrarily, we observed numerous mature stomata on the abaxial surface of the leaf as well (*see also* Foster and Gifford, 1959). The table below describes the distribution of stomata (per sq. mm.) on 5 leaves :

	Upper epidermis	Lower epidermis
1	24	38
2	17	45
3	21	45
4	14	28
5	14	31

As shown in Fig. 1 B, they are quite conspicuous on the sides of the lamina, but are absent along the midrib, margins, and the tip. A few longitudinally arranged stomata occur on the stem. These are not so conspicuous and can be distinguished from those on the leaves by a much-reduced cuticular thickening around the pore.

The mature stomata are of the anomocytic type (Fig. 1 C, E), and follow the haplocheilic mode of ontogeny (also reported by Sykes, 1908). They have a thick cuticular lining around the stomatal aperture, and a substomatal chamber is generally missing (Fig. 1 F).

We express our gratitude to Professor B. M. Johri for encouragement and to Dr. N. N. Bhandari for going through the manuscript.

Department of Botany,   G. S. PALIWAL.
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BIOCHEMICAL CHANGES DURING REGENERATION OF ROOTS IN AIR LAYERS OF MANGO (*MANGIFERA INDICA* L.)

MANGO is a difficult-to-root fruit plant. It is generally propagated by inarch grafting on seedling stocks. Remarkable root-promoting effect of IBA giving cent per cent success in air layerings has, however, been obtained.[1,2] With the view to elucidating the root-promoting effect of this chemical a study was undertaken, on the biochemical changes during regeneration of root in air layerings of mango var. Langra,

taking samples of bark and wood from the root forming region, upto 4 cm. above the ring cut, from three kinds of materials : (*i*) L/IBA—layerings treated with IBA 3000 ppm., (*ii*) L—layering without IBA and (*iii*) C—control, comparable shoots not layered, their samples taken from region corresponding to that of (*i*) and (*ii*), at four stages, *viz.*, (S_1)—initial, and at the time of giving ring cut ; (S_2)—pre-callusing, swelling stage, 8 days after ringing ; (S_3)—callusing, 19 days after ringing ; and (S_4)—root emergence, 34 days after ringing. In layerings treated with IBA 80% successfully rooted as against only 40% in layerings made without IBA.

A progressive increase in total carbohydrates (reserve polysaccharides and soluble sugar) took place in bark and wood both under treatments L and L/IBA. There was little difference in the contents of different carbohydrate fractions under these two treatments at the precallusing stage, but at callusing and root emergence stages treatment L was found to contain relatively greater quantity of available carbohydrates than under L/IBA. This was perhaps due to greater utilization of carbohydrates under L/IBA where callusing and root formation were greater. There was very little change in the contents of different carbohydrate and nitrogen constituents under C during the 34-day period of study.

Soluble nitrogen concentration of bark and wood increased in identical manner under treatments L and L/IBA during precallusing and callusing and registered a similar fall at root emergence. Although there was a net increase in protein nitrogen concentration in bark at root emergence under L and L/IBA, it was noted that the increase in soluble nitrogen at precallusing and callusing was accompanied by a corresponding decrease in protein nitrogen at these stages, indicating an increase in hydrolytic activities as a result of ringing. At emergence of roots, however, synthesis of proteins assumed greater importance.

Detailed studies on soluble nitrogen constituents by paper chromatography revealed presence of 15 amino acids in bark and wood. In bark the amino acids alanine, γ-amino butyric acid, serine and glycine (taken together), glutamic acid and aspartic acid showed significant changes during regeneration of roots. In wood tissue arginine and histidine (taken together), alanine, serine and glycine and glutamic acid exhibited greater changes than the other amino acids (Fig. 1). Concentration

of arginine and histidine which was very high in wood fell sharply through the stages of root formation both under L and L/IBA and at root emergence reached a value much below that

FIG. 1. Changes in alanine concentration (μgm./gm. dry wt.) in bark and wood of root forming region of mango layers at different stages of regeneration.

under C. However, concentration of some of the amino acids rose appreciably soon after ringing (Table I). In both bark and wood

and glutamic acid in wood was more or less similar to alanine. Glutamic acid in bark showed an increase upto callusing stage after which a steady level was maintained till emergence of roots. In wood, concentration of serine and glycine, after showing a slight rise under L at precallusing, fell steadily, registering a value much below normal at emergence of roots. Under L/IBA, however, the fall in concentration started only after callusing. Although the fluctuation in aspartic acid in wood was not appreciable, the level of this amino acid in bark rose gradually till root emergence both under L and L/IBA; the concentrations in the latter being higher at all the stages. Also, it was of interest to detect the presence of asparagine in the bark only under treatment L/IBA which proved superior to L in rooting of air layers.

It is suggested that the beneficial effect of ringing, which is done in air layering is, in part, due to accumulation of carbohydrates in the root forming region. That such a condition of tissue stimulates rooting, has been observed by many workers.[3-5] The beneficial effect of ringing is most likely related to the changes in concentrations of amino acids as well. Treatment with IBA improves rootability of layers and its effect might be associated at least, in part, with maintenance of a steady increase in level of amino acids like alanine, γ-amino-

TABLE I

Amino-acid contents (μ gm./gm. dry wt.) in bark and wood of root-forming region of mango layers, at different stages of regeneration

Amino acids	Treatments:	C				L			L/IBA		
	Stages:	S_1	S_2	S_3	S_4	S_2	S_3	S_4	S_2	S_3	S_4
Bark:											
Alanine	..	70	65	61	64	293	180	82	213	271	101
γ-aminobutyric acid	..	21	23	15	18	103	77	31	61	80	50
Serine and glycine	..	36	39	34	30	87	62	19	78	62	34
Glutamic acid	..	21	13	10	11	75	65	54	47	60	64
Aspartic acid	..	7	8	11	12	32	35	62	49	71	74
Wood:											
Arginine and histidine	..	1531	1464	1402	1378	921	1014	364	934	1076	478
Alanine	..	166	155	171	146	484	265	125	366	247	215
Serine and glycine	..	171	169	181	175	188	138	67	164	167	99
Glutamic acid	..	64	72	60	64	188	116	34	112	118	68

alanine registered a high increase in L at the precallusing stage and then fell steadily till it reached the original level at emergence of roots. Under L/IBA alanine continued to rise till callusing and thereafter fell steadily. The trend of fluctuation in concentration of γ-aminobutyric acid and serine and glycine in bark

butyric acid and glutamic acid till callusing stage.

Studies on the hormonal aspects of regenerating mango layers are in progress.

The Royal Agri-Horticultural Society of India, Calcutta, has been good enough to afford garden facilities and laboratory accommodation.

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SOME ADDITIONS TO INDIAN SOIL FUNGI

DURING the course of investigation of rhizosphere mycoflora of some medicinal plants the following fungi were isolated. Their diagnostic characters are as follows :

Amerosporium applanatum Berg. et Curt., Sacc. in *Syll. Fung.*, 3, 682, 1884.

Colonies on oat-meal agar produce creeping mycelium, at first hyaline becoming brownish due to the formation of pycnidia. Pycnidia superficial formed in abundance, at first light brown becoming dark brown at maturity, varying in shape from globose, subglobose, angular to bean-shaped, $240-300 \times 165-240\,\mu$ with setæ on all sides ; setæ septate, brown, downward black and opaque, upward lighter, curved and coiled at tips, coiling in circinate manner, $36-66 \times 4\cdot5-6\,\mu$; spores extruded in mass by irregular rupturing of pycnidium, aseptate, subglobose to elliptical, slightly dark or olive colour, $5-6 \times 3\,\mu$.

The fungus was isolated from rhizosphere of *Withania somnifera* Linn. in September 1966.

Helminthosporium accedens Syd., *Annals. mycol.*, 1904, p. 173.

Colonies on Czapeks's agar broadly spreading brown to black-coloured consisting of aerial and submerged hyphæ, conidiophore erect, simple, often curved and geniculate, dark brown, septate $55-75 \times 6\,\mu$; conidia single at the apex, long cylindrical, tapering toward the ends, septa five to eight, light brown, $24-48 \times 6-9\,\mu$.

The fungus was isolated from rhizosphere of *Datura alba* Nees. in September 1966.

Volutella allii Patters., *Bull. Torrey bot. Cl.*, 1900, p. 286.

Sporodochia disc-shaped, subglobose, dark brown to black, $300\,\mu$ in diameter, with rigid, dark-coloured, long marginal setæ arising from the base, $108-240 \times 6\,\mu$; Conidiophore dense, hyaline or olivaceous in colour, $18-20 \times 3\,\mu$; Conidia hyaline, fusiform, falcate, $18-24 \times 3\cdot3-5\,\mu$.

The fungus was isolated from rhizosphere of *Withania somnifera* Linn. in October 1966.

Volutella acalyphœ Atk., *Bull. Cornell Univ.*, III, No. 1, 1897, p. 49.

Colonies on Czapek's agar broadly spreading, grayish-brown with superficial whitish aerial mycelium in old cultures, reverse dark brown. Sporodochia subglobose, $300-400\,\mu$ in diameter, dark brown to black, with long, septate, dark-coloured setæ arising from the base, setæ $150-210 \times 5-6\,\mu$; Conidiophore cylindrical, sub-hyaline $24-30 \times 3-4\,\mu$; Conidia hyaline, falcate, fusoid $25-30 \times 2\cdot5-3\,\mu$.

FIGS. A–D. Fig. A. *Amerosporium applanatum* Berk. et Curt. (1) Pycnidium ; (2) Seta ; (3) Pycniospores. Fig. B. *Helminthosporium accedens* Syd. (1) Conidiophore ; (2) Conidia. Fig. C. *Volutella allii* Patters. (1) Sporodochium. (2) Conidia ; (3) Seta. Fig. D. *Volutella acalyphœ* Atk. (1) A part of sporodochium. (2) Conidia ; (3) Seta.

The fungus was isolated from rhizosphere of *Withania somnifera* Linn. in November 1966.

Thanks are due to Dr. R. Y. Roy for guidance and Prof. R. Misra for providing laboratory facilities.

Department of Botany,   P. C. GUPTA.
Banaras Hindu University,
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REVIEWS AND NOTICES OF BOOKS

1965 Brandeis University Summer Lectures in Theoretical Physics (Vols. I and II). Edited by M. Chretien and S. Deser. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Volume 1: Pp. 516. Price $ 32.50 ; Volume II : Pp. 690. Price $ 35.00.

The 1965 Brandeis Summer Institute lectures dealt with two areas of theory which are currently both extremely active and in which much progress is being made. Particle symmetries and axiomatic field theory are at first sight rather separate subjects ; it was felt, however, that it would be of particular benefit for students in each to be exposed to the methods and concepts of the other. Axiomatics has recently begun to furnish results of concrete value even to the more pragmatic theoreticians. This is brought out by the lectures of Epstein, Heep and Robinson, which represent three complementary and successful current approaches by leading exponents.

The lectures of Michel, while included in the axiomatics section for editorial reasons, chiefly present some applications of modern, sophisticated mathematics to recent symmetry group theorems. In terms of mathematical depth, they belong with the axiomatics lectures, but their physical content makes them a part also of the particle symmetries area. The latter is here represented by Cabibbo, Cutkosky, B. W. Lee and Low. These lecturers between them covered four major topics of particle theory, topics in which their own contributions have been highly significant.

Included in these lecture notes are also shorter contributions in special active areas, by T. D. Lee and Newton, as well as a most useful survey of the present experimental situation in elementary particles by Rosenfeld. *The 1965 Brandies Summer Institute in Theoretical Physics* was made possible by the generous support of the National Science Foundation and of NATO.   C. V. R.

Italian Physical Society (Course 33. *Strong Interactions*). By L. W. Alvarez. (Academic Press, New York and London), 1966. Pp. xi + 225. Price $ 11.50.

This book contains the Proceedings of the International School of Physics "Enrico Fermi," Course XXXIII held at Varenna on Lake Como,

Villa Monastero from 6th to 18th July 1964. The Course was directed by Prof. L. W. Alvarez and it was attended by 78 members.

This book contains discussions of the experimental facts concerning meson and baryon resonances. The presentation is directed toward the elucidation of theories that will explain the presently known phenomena which could be subjected to experimental tests in the near future.

The contents of this volume are : L. W. Alvarez, Introduction ; D. H. Miller, Meson Resonances ; R. D. Tripp, Baryon Resonances ; R. H. Dalitz, The Production and Decay of Resonant States ; and S. L. Glashow, Symmetries of Strong Interactions.   C. V. R.

Metallurgical Society Conferences (Vol. 36. *Local Atomic Arrangements Studied by X-Ray Diffraction*). Edited by J. B. Cohen and J. E. Hilliard. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Pp. 381. Price $ 22.00.

This volume represents the Proceedings of a Symposium sponsored by the Physics and Chemistry of Metals Committee of the Institute of Metals Division, the Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers, Chicago, Illinois, February, 1965.

The contents are : Part I : Heterogeneities : Symbols for Part I. Chapter 1 : Methods of Analysis for Diffuse X-ray Scattering Modulated by Local Order and Atomic Displacements ; Chapter 2 : A Theoretical and Analogue Study of Diffraction from One-Dimensional Modulated Structures ; Chapter 3 : Local Order in Solid Alloys—I ; Chapter 4 : Local Order in Solid Alloys—II ; Chapter 5 : Local Order in Liquid Alloys ; Chapter 6 : Correlation of Local Order with Mechanical Properties ; Part II : Line Broadening : Symbols for Part II. Chapter 7 : Analysis of the Broadening and Changes in Position of Peaks in an X-ray Powder Pattern ; Chapter 8 : Evaluation from X-ray Diffraction Profiles of Fourier Coefficients and the Microstrain Distribution Function ; Chapter 9 : Examples of Applications of Line Broadening ; Chapter 10 : Analysis of Thin Films ; and Chapter 11 : X-ray and Fatigue Studies of Hardened and Cold-Worked Steels.   C. V. R.

Recent Developments in Particle Symmetries. Edited by A. Zichichi. (Academic Press, New York and London), 1966. Pp. xii + 460. Price $ 12.00.

During two weeks in September-October 1965, 90 physicists from twenty-six countries met in ERICE to attend the third course of the International School of Physics "Ettore Majorana," the proceedings of which are contained in this book.

The titles of the major topics dealt with in this book are as follows : Lectures : Higher Symmetries, by A. Pais ; Deviations from Unitary Symmetry, by D. H. Sharp ; Broken Symmetries and Sum Rules, by N. Cabibbo ; Difficulties of Relativistic U(6), by J. S. Bell ; CP Violation, by J. Prentki ; CP Violation and K Decay, by J. Steinberger ; Proton-Anti-Proton Annihilations at Rest, by P. Franzini ; Closing Lecture—The Significance of Internal Symmetries, by L. A. Radicati ; *Seminars* : Low-Energy Hyperon-Proton Interactions, by C. A. Snow ; Strange Resonances, by S. Focardi ; Invited Discussion following the Focardi Lecture, by V. P. Henri ; Current Experiments at Desy, by U. Meyer-Berkhout ; The Electron Spectrum from Muon Decay, by J. Lee Franzini ; and Superconductors : Superconducting and Otherwise, by L. N. Cooper. C. V. R.

The Biochemistry of Copper. Edited by J. Peisach, P. Aisen and W. E. Blumberg. (Academic Press, New York and London), 1966. Pp. xvi + 588. Price $ 23.50.

The numerous and varied aspects of the role of copper in biological systems are described in this volume which includes contributions from outstanding biochemists, biologists, chemists, clinicians, and physicists.

Some of the highlights of the book are a detailed X-ray crystallographic study of copper peptides relating to structural problems of copper protein chemistry, a study of the role of copper in electron transport, and up-to-date reviews of cytochrome oxidase, laccase, and Wilson's disease. The latest findings for ceruloplasmin as well as for other copper proteins are broadly discussed. C. V. R.

Ion Exchange (Vol. 1). Edited by Jacob A. Marinsky. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1966. Pp. xi + 424. Price $ 16.75.

This book, the first volume of the series, *Advances in Ion Exchange*, is intended primarily to provide the reader with an educated consideration of important aspects of the ion-exchange phenomenon.

Some of the important aspects of the ion-exchange phenomenon considered in this volume, of interest to scientists with biochemical, biophysical, biological, and physical-chemical orientation, are ion-exchange selectivity, polyelectrolyte behavior, liquid ion exchangers, inhomogeneity of ion-exchange materials, kinetics of ion exchange between beads and solution, membrane transport processes, and ion-exchange systems using microscopy. Emphasis has been placed by each author on extension of the boundaries of the problem under discussion. It is hoped that new and exciting directions of research in various aspects of ion exchange will be exposed to the reader in this first volume of the ion-exchange series.

C. V. R.

Light as an Ecological Factor. Edited by R. Bainbridge, G. C. Evans and O. Rackham. (Blackwell Scientific Publications, Oxford), 1966. Pp. xi + 452. Price 84 *sh.*

Light occupies a special place as an ecological factor because of the number, diversity and importance of the effects which it produces on both plants and animals, because of the complexity of the light climate, and the difficulties which have attended attempts to measure and characterize it.

This book contains the proceedings of the Symposium of the British Ecological Society held at Cambridge from 30th March to 1st April 1965. The subjects covered in this Symposium include the light climate in general, micrometeorology and methods of measuring and characterizing the light climate in the open ; woodlands and forests ; light penetration, opacity and scattering in the open sea, and the influence of these factors upon contrast perception, the sensitivity of the eye and the visibility of underwater objects ; and the effect of light on pigmentation and movement of organisms in the littoral zone. C. V. R.

Dover Paperback Republication. (Dover Publications, 180, Varick Street, New York-14, New York) :

1. **The Photochemistry of Gases.** By W. A. Noyes, Jr. and P. A. Leighton. Pp. 475. Price $ 3.00.

This is an unabridged republication of the original edition published in 1941 by the Reinhold Publishing Corporation. The authors present a critical review of one aspect of photo-

chemistry, namely, that of reactions in the gas phase.

2. **The Phase Rule and Heterogeneous Equilibrium.** By J. E. Ricci. Pp. 505. Price $ 3.25.

This is an unabridged and corrected republication of the original work published in 1951 by the D. Van Nostrand Company. The book offers a systematic study of the meaning and application of the Phase Rule which may be general enough to be used as reference for almost any application of the principles.

3. **Microscopy for Chemists.** By H. F. Schaeffer. Pp. 264. Price $ 2.00.

This is a republication of the book originally published in 1953 and again reprinted in 1956. The book is in two parts ; the first part of about 160 pages deals with the basic principles, optics, and use of microscope. The second part describing 32 experiments can be used as a laboratory manual.

4. **Introduction to Statistical Machanics.** By R. W. Gurney. Pp. 268. Price $ 2.00.

This is an unabridged and unaltered republication of the original book published by McGraw-Hill Book Co., Inc., in 1949.

5. **Microwave Spectroscopy.** By W. Gordy, W. V. Smith and R. F. Trambarulo. Pp. 446. Price $ 3.00.

The original work was published by John Wiley and Sons, Inc., in 1953. The authors present a high-level survey of available information on microwave spectroscopy to meet the needs of working scientists in this field.

6. **Laplace Transform Theory and Electrical Transients.** By S. Goldman. Pp. 440. Price $ 3.00.

The original book was published by Prentice-Hall, Inc., in 1949, under the title *Transformation Calculus and Electrical Transients.* It went through five reprints by 1955. The Dover edition is a republication of the last reprint. The book is written at the level of seniors or graduate students in electrical engineering or applied mathematics.

Engineering Mechanics (Vol. 1 : *Statics*). By T. C. Huang. (Published by Addison-Wesley Publishing Company. Inc., 10-15, Chitty Street. London W. 1). Pp. 419.

This two-volume publication, the first on Statics and the second on Dynamics, is intended as a text-book for the sophomore-junior level

students in engineering schools. The author has brought in the treatment some modern approach which he has found useful in the teaching of the mechanics of particles and rigid bodies.

The volume on Statics covers the course in five chapters. The first three chapters planned to provide foundation knowledge deal respectively with Basic Concepts, Elements of Vectors, and Forces. The Statics part is dealt with in the next two chapters on Equilibrium of Force Systems, first by Force method and second by Work and Energy methods.

The book is profusely illustrated and contains a large number of worked examples and a still larger number of problems to link theory and applications. A. S. G.

Basic Microscopic Technics. By Ruth McClung Jones. (The University of Chicago Press, Chicago and London ; 70, Great Russel Street, London W.C. 1 and 5750, Ellis Avenue, Chicago, Illinois 60637), 1967. Pp. 334. Price 48 *sh.* or $ 6.50.

Guyer's classic manual and text-book, *Animal Microbiology,* which was first published early in the century and which went through five editions, had remained a popular and useful guide, for well over half a century, both for students beginning the study of microtechniques and for instructors who make microscopic preparations for their classes. The author in the book under review has followed the general plan and essential spirit of Dr. Guyer's book, but on the basis of her own rich experience in teaching microscopic techniques, has broadened the scope, and also has made it up to date by including newer methods that have come into use within the last decade.

It is an essential laboratory hand-book for all students of biological sciences. A. S. G.

Books Received

A Guide to the Solar Corona. By D. E. Billings. (Academic Press, New York), 1966. Pp. xiv + 338. Price $ 11.95.

Methods in Bremsstrahlung Research. By O. V. Bogdankevich and F. A. Nikolaev. (Academic Press, New York), 1966. Pp. x + 323. Price $ 9.50.

Precis of Special Relativity. By O. Costa De Beauregard. Translated by H. Hoffmann. (Academic Press, New York), 1966. Pp. xiii + 123. Price $ 5.75.

A NOTE ON RELATIONSHIP BETWEEN NARMADA RIFT VALLEY AND OCCURRENCES OF CARBONATITES

D. D. YELLUR

Geological Survey of India, Ahmedabad-9

CARBONATITE complexes occur along the Narmada Rift Valley at Netrang in Broach District, Ambadongar in Baroda District of Gujarat State in the west, and Barwaha in Khargone District of Madhya Pradesh in the east. These complexes are circular or oval in plan with 5 to 25 sq. km. area. The carbonatites are igneous rocks found as subvolcanic plugs consisting largely of carbonates usually calcite/ dolomite. In these complexes, the carbonatites are associated with alkaline felspathoidal (nepheline and/or melilite bearing) rocks and with metasomatised country rocks known as fennites. Besides the above-mentioned noteworthy occurrences, several minor lenticular outliers of metamorphic carbonate rich rocks and metamorphic limestone are disposed in a linear en-echelon pattern in the Deccan traps all along the Narmada Valley, but these have not been proved to be carbonatites.

The association of carbonatites, alkaline felspathoidal syenites and basic suites of rocks of Deccan volcanic episode throws considerable light on the volcanic activity of the early Tertiary Era besides indicating their mutual intrusive time-phase relationship. Such relationship is clearly illustrated in the massive basic igneous complex at Phenaimata in Baroda District, which shows layers of gabbro and basalt intruded by leucite and nepheline-bearing felspathoidal suite of rocks. In Ambadongar area the traps are intruded by felspathoidal syenites which in turn are intruded by carbonatites. Such relationship indicates that the basic, felspathoidal and carbonatite suites of rocks were emplaced in three distinct magmatic phases of volcanic activity. The possibility of late solfataric phase succeeding the carbonatite magmatism cannot be ruled out, for, occurrences of pyrite associated with Bagh limestone are reported around Kathi area in Narmada Valley bordering Maharashtra.

The course of Narmada river and its tributaries is governed by fault systems of middle Eocene epoch. The fault system may be resolved into the following main groups in order of their antiquity : (1) E.N.E.-W.S.W. to E-W main rift faults with several parallel sympathetic faults. The southern rift faults hading 65° to 75° north have successive down-throw towards north resulting in step-like disposition of the Deccan traps and Infra-trappean rocks. The northern rift fault also associated with sympathetic faults have E.N.E-W.S.W. to E-W trend and hade 65° to 75° towards south causing successive down-throw towards south. These blocks faults in combination have caused a series of down-thrown blocks resulting in step-like topography of the rift valley. (2) A second set of high angle faults trending North-South to N.E.-S.W. and hading 75° to 85° towards west, north-west as well as towards east and south-east has produced successive southerly shift of the Narmada Valley when traced from Madhya Pradesh to Broach in Gujarat. A notable effect of this set of faults is that the 900-mile river course gradually drops from about 1000 m. height in Madhya Pradesh to sea-level at Broach and is marked by a series of natural rapids and waterfalls. (3) The third set of faults, offsetting the earlier two, has N.W.-S.E. trend with 65° to 75° dip and throw towards north-east. The above three sets of faults extend well into the Saurashtra region where these faults have caused extensive fissures along which the later basic intrusives have been emplaced.

FIG. 1. Location map of carbonatite occurrences along Narmada valley.

The overall structural set-up of the Narmada Valley caused by the superimposed fault patterns enumerated above shows that the rift valley was a region of great crustal weakness

where deep crustal fractures accentuated volcanic activity during which the carbonatite complexes were emplaced in the form of plugs.

Detailed study of the Narmada Rift Valley may bring to light many more carbonatite complexes both in the from of plugs and dyke-like intrusions emplaced along fault planes, which may have great economic significance as the deposits of niobium (columbium), rare-earths (cerium group), atomic minerals, fluorspar and apatite are known to be associated with them.

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STRATIGRAPHIC SUCCESSION OF THE BIJAWAR ROCKS IN THE TYPE AREA (BETWEEN BIJAWAR AND SILON), CHHATARPUR DISTRICT, M.P.

BHAGWAN DAS AND S. U. KHAN

Centre of Advanced Study in Geology, University of Saugar

THE studies of the Bijawar rocks have remained a much neglected topic of research in Indian stratigraphy. H. B. Medlicott in 1860 (*Mem. Geol. Surv. Ind.,* 2, p. 6) proposed the name "Bijawar" for the sediments found above the Bundelkhand granites and below the lower Vindhyan beds. He remarked that "the Bijawar formation is too confused to allow of the safe or ready determination of subdivision". A note, published by S. M. Mathur in 1954 (*Rec. Geol. Surv. Ind.,* 86, pp. 539–544), gives an account of the earlier work on the area together with the lithology of the Bijawar formation and its relationships with the overlying and underlying rocks. He has also presented a tentative table of the stratigraphic succession. In the past, several attempts have been made to work out its exact lithologic sequence, but enough success was not achieved. Its stratigraphic position has still remained a controversial problem and the tectonic details have not been attempted. The senior author feels that identification and correlation of similar rocks present along the Narmada and the Son valleys are possible only after working out the stratigraphic sequence and tectonics of the Bijawar rocks of the type area in every detail.

In the Pre-Cambrian terrain of excessive and repeated orogenic disturbance it is often very difficult to ascertain with certainty the original order of superposition of beds, unless features indicating the original top or bottom of the sequence are discovered and properly analysed. In course of lithologic and structural mapping of the rocks between east of Bijawar Town and Silon, the authors have discovered several perfectly preserved sedimentary structures. Amongst the several inherited structures, cross-bedding, ripple-marks and graded bedding have best served as reliable top-and-bottom criteria.

By the proper utilization of the several top and bottom features in the sub-metamorphic rocks around Bijawar, it has been possible to establish the following order of superposition:

Carbonatite-alkalic complex

VINDHYAN ROCKS

Upper Bijawar	Quartzitic sandstone	Greyish-white quartzitic sandstone
	Chocolate shale with tillites (?)	Chocolate shale to slate with ash-coloured silt, grit and sandstone bands (locally tillites ?)
	Ferruginous conglomerates	Medium-grained and heterogeneous ferruginous conglomerate
Lower Bijawar	White quatzites	Friable and white sandstone; Gritty and pebbly sandstone; Hard and white quartzite with pebb.es; Hard and white quartzite
	Homogeneous conglomerate	Homogeneous very coarse conglomerate
	Ferruginous quartzite	Ferruginous quartzite mottled with white quartzite; Ferruginous quartzite with shale and grit bands
	Ferruginous shale	Hard dark brown ferriferous and siliceous shale
	Cherty quartzites	Pink and white cherty quartzite with gritty bands; Brown cherty quartzite with bands of jasperite

Bundelkhand Granites

Although several outcrops of metamorphosed basic igneous body in the sub-metamorphic rocks have been reported by earlier workers, the presence of an intrusive carbonatite-alkalic complex is recorded here, for the first time, from the type area of Bijawars. The complex transects the Bundelkhand granites, Bijawars and Vindhyans, and therefore is Post-Vindhyan in age.

B. Das is of opinion that the above geologic succession should be valid for the other parts of the Bijawar belt lying immediately south of the Bundelkhand granites and broadly applicable in the cases of such rocks found elsewhere. This should also be of great value in the identification and correlation of such rocks in the Narmada and the Son valleys. Detail lithologic and structural mapping by the authors have produced results of considerable tectonic significance, which are under analysis.

CHEMICAL EXAMINATION OF THE STEMS AND LEAVES OF MARSDENIA VOLUBILIS T. COOK

D. VENKATA RAO, E. VENKATA RAO AND N. VISWANADHAM

Department of Pharmacy, Andhra University, Waltair

M*ARSDENIA VOLUBILIS* T. Cook (Syn.: *Dregia volubilis* Benth. *ex.* Hook. *f*) (Fam.: Asclepidaceæ) is a stout tall climbing shrub growing wild in many parts of India. In Ayurvedic medicine the plant has been described[1] as cure for several diseases. The seeds of this plant have been examined by Reichstein *et al.*[2,3] who reported the isolation and chemistry of ester glycosides made up of steroid genins and 2-deoxy sugars. Similar compounds were also reported to be present in *Marsdenia tomentosa*.[4] In this communication the results of the chemical investigation of the stems and leaves of *M. volubilis* are reported.

The air-dried stems and leaves were powdered and extracted successively with hexane, chloroform and alcohol. The hexane extract on concentration deposited a very small quantity of a red pigment. The residue was chromatographed over alumina. The petroleum-ether-benzene (17:3) eluate yielded a colourless crystalline substance, needles from benzene, m.p. 277–79°, $[\alpha]_D^*$ ± 2°. It gave positive Liebermann-Burchard reaction (pink) and analysed † for the formula $C_{30}H_{50}O$. It formed a monoacetate, $C_{32}H_{52}O_2$, m.p. 297–300°, $[\alpha]_D$ + 12·3° and a monobenzoate, $C_{37}H_{54}O_2$, m.p. 289–92°, $[\alpha]_D$ + 39·4°. These properties led to the conclusion that the substance s taraxerol and a mixed m.p. determination of the substance and its benzoate with authentic taraxerol and taraxerol benzoate respectively confirmed the identity.

From the mother liquors of taraxerol another triterpenoid was obtained in small yield, nodules from petroleum ether, m.p. 87–88°, $[\alpha]_D$ — 8·7°. It analysed for the formula $C_{30}H_{50}O$ and formed a monoacetate, $C_{32}H_{52}O_2$, white crystalline powder from petroleum ether-benzene, m.p. 77–80°.

In the same chromatography petroleum ether-benzene (5:1) eluted a sterol (green colour in Liebermann-Burchard reaction), colourless feathery needles from petroleum ether, m.p. 158–60°, $[\alpha]_D$ — 37°. It analysed for the probable formula $C_{28}H_{48}O$ and formed a monoacetate, $C_{30}H_{50}O_2$, needles from ethanol, m.p. 137–38°, $[\alpha]_D$ — 39·2° and a monobenzoate, $C_{35}H_{52}O_2$, prisms from ethanol-benzene, m.p. 149–53°, $[\alpha]_D$ — 10·1°.

The chloroform extract residue of the plant material was chromatographed over alumina and all the fractions thus obtained gave positive Keller-Kiliyani reaction, indicating the presence of 2-deoxy sugars, and negative Legal and Kedde reactions. Hence these fractions may contain ester glycosides of the type isolated from the seeds by Reichstein *et al.*[3]

The alcohol extract was concentrated under reduced pressure and all the alcohol was removed by adding water at intervals. The aqueous liquid thus obtained was extracted successively

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with petroleum ether, ether, ethyl acetate and p-butanol. The petroleum ether fraction gave only a waxy residue. The ether extract on concentration deposited a yellow solid which on repeated crystallization from alcohol gave an yellow crystalline substance, m.p. 276–78°. The substance answered the characteristic colour reactions of flavanols and analysed for $C_{15}H_{10}O_6$ (a tetrahydroxy flavone). It formed a tetra-acetate $C_{23}H_{18}O_{10}$, feathery needles from alcohol, m.p. 183–85°. The properties of the flavone and its acetate indicated that it might be identical with kæmpferol. This was confirmed by a direct comparison (mixed m.p. and paper chromatography kindly carried out by Prof. S. Rangaswami) with authentic samples of kæmpferol and its acetate.

The ethyl acetate extract on concentration gave a very small quantity of a pale yellow solid which crystallized from alcohol as pale yellow prisms. Its colour reactions indicated that it was a flavanol glycoside. Hydrolysis of the glycoside with alcoholic hydrochloric acid gave an aglycone which was shown to be kæmpferol by paper chromatography. The sugars were identified as glucose and galactose by paper chromatography. Further, colou reactions of the glycoside and the aglyconc with neutral lead acetate and zirconiumoxy-chloride-citric acid[5] showed that the sugar residue is attached to the 3–OH of kæmpferol

From the butanolic extract a powdery solid was obtained whose properties indicated the presence of saponins. It also gave a pink colou with Mg-HCl and an yellow precipitate with neutral lead acetate. Hydrolysis with acid afforded a flavonol, identified as kæmpferol. Attempts to separate the flavonol glycoside from the saponin were not successful.

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ON ADULTS OF THE SUBULURID INFECTIVE LARVA FROM TENEBRIONID BEETLE WITH REMARKS ON THE VALIDITY OF *SUBULURA MINETTI* BHALERAO

S. C. MATHUR AND B. P. PANDE

Department of Parasitology, U.P. College of Veterinary Science and Animal Husbandry Mathura

THE subulurid infective larva from *Gono-cephalum depressum* F., commonly found in and around the Poultry Units, developed successfully into the preadults of *Subulura minetti* Bhalerao, 1941, described from fowls at Jaipur (Srivastava and Pande, 1967). A number of specimens collected from 258 beetles, during the teaching session 1966-67, yielded fully mature worms in feeding experiments with laboratory raised clean chicks. The adults recovered were studied to determine their correct identity and to examine the validity of *S. minetti*.

The cysts and the excysted juveniles, in matter of size and structure, conformed to the account given by Srivastava and Pande (loc. cit.). A dose of 100 cysts or 88 excysted specimens was administered to the experimental chicks. On postmortem, one of the infected chicks yielded, from its cæcum, a 7-day old juvenile which (Fig. 1), with nearly rounded anterior pointed posterior ends and 1·920 mm. length and 0·096 mm. width, had the œsophagus with its characteristic posterior bulb of 0·560 mm. length—the bulb being 0·088 × 0·069 mm. in size; the nerve ring and excretory pore at 0·120 mm. and 0·254 mm. distance respectively behind the anterior end, and the anus opening at 0·142 mm. distance in front of the posterior extremity. Evidence of rudiments of external genitalia was, however, lacking.

The droppings of the two chicks became positive for characteristic eggs 60 and 66 day respectively after the infection. On autopsy 6 males and 13 females were collected—4 male and 11 females from one chick and 2 male and 2 females from the other,

Adults.—The whitish and cylindrical worms had 3 lips and 6 papillæ around the head, the cephalic alæ and a thick and chitinous buccal capsule with 3 teeth at its base.

The males, with the tail ending in a ventrally curved prolongation, a preanal sucker without a chitinous wall but surrounded by radiating muscle fibres, 11 pairs of small caudal papillæ—3 pairs preanal, 2 adanal and 6 pairs postanal, the large but equal and alate spicules and a triangular gubernaculum (Fig.. 2), measured 9·180 to 10·620 mm. in length and 0·280 to 0·300 mm. in width, the buccal capsule being 0·050 to 0·065 mm. in length, the œsophagus 1·2 to 1·380 mm. long, the œsophageal bulb of 0·175 to 0·200 × 0·190 to 0·205 mm. in size, the preanal sucker of 0·085 to 0·125 mm. in size, the spicules and the gubernaculum of 0·775 to 0·900 mm. and 0·160 to 0·175 mm. length respectively.

width of 0·368 to 0·400 mm., the other measurements being : the buccal capsule 0·067 mm. in length, the œsophagus 1·648 to 1·800 mm. long, the nerve ring and the excretory pore at 0·466 and 0·560 mm. distance respectively behind the anterior end, the tail 0·880 mm. long, the vulva at 5·856 mm. behind the anterior extremity, the ovijector 0·154 mm. long and the eggs of 0·0962 × 0·0847 mm. in size.

A perusal of the account for *S. minetti* and the characters on which this species has been distinguished would reveal that reliance has mostly been placed on the character of the head, the size of the spicules, the gubernaculum and the preanal sucker in males and, in females, on the location of vulva on a prominence and the character of the ovijector. The available specimens exhibited 6 cephalic papillæ, the vulva carried on a prominence and the ovijector provided with a distinct sphincter. *S. minetti*

FIGS. 1–4 (Camera lucida drawings). Fig. 1. 7-day old juvenile of *S. brumpti*. Fig. 2. Posterior end of a male specimen. Fig. 3. Part of a female showing vulva, vagina, sphincter ovijector, and distal regions of uteri. Fig. 4. Magnified view of vulvar region

In females, with a conical tail ending in a pointed tip, the vulva situated on a slight prominence and opening into a vagina connected with a prominent ovijector provided with a sphincter and receiving the distal ends of the 2 uteri (Figs. 3 and 4) and thin-shelled somewhat subspherical and fully embryonated eggs, the length was 12·640 to 15·100 mm. and the

is believed to be without a distinct sphincter on its ovijector. According to Deo (1964), the muscular sphincter was not noticed but the ovijector, of 0·386 mm. in size and directed anteriorly, consisted of a muscular portion which proximally enlarges and forms a cup-shaped cavity in which a 'circular hyaline area' is enclosed. It appears that Deo (1964) failed

to notice the sphincter portion of the ovijector. The caudal papillæ in *S. minetti*, according to Deo, were in 10 pairs. A total of 11 pairs was observed in the present material. In *S. brumti* there were 5 pairs of preanals and 5 pairs of postanals. 6 pairs of preanals, as stated by Deo (1964), have been reported by Gendre (1909) and Gedoelst (1916). Evidently, the number varies from 10 to 11. No differential characters can thus be found between these two species. *S. minetti* is, therefore, suppressed as a synonym of *S. brumpti* which, in Indian region, has its intermediate host in *G. depressum* F. known from other countries as well (Soulsby, 1965). Its prepatent period, under our conditions, is 60 to 66 days.

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MORPHOLOGICAL CLASSIFICATION OF THE DENDRITIC CELLS OF THE EPIDERMIS OF THE BLACK GUINEA-PIG

R. C. SHUKLA

Central Drug Research Institute, Lucknow

SHUKLA,[1,2] on the basis of biometric and morphologic analysis, classified the DOPA negative dendritic cells of the epidermis of the black guinea-pig, having 5, 4, 3 and 2 dendritic processes, as Type I, II, III and IV Langerhans' cells, respectively. In the present communica-

Shukla, Karkun and Mukerji.[4] The digest is mounted on albuminised slides and examined under the microscope. On the basis of the strength of DOPA response and the number of the dendritic processes, the following types of cells are recognised in the mount:

Type	1.	DOPA (+)	cell having 8 dendritic processes	Melanocytes (Group A)
Type	2.	DOPA (+)	cell having 7 dendritic processes	
Type	3.	DOPA (+)	cell having 6 dendritic processes	
Type	4.	DOPA (+)	cell having 5 dendritic processes	
Type	0'	DOPA (±)	cell having 6 dendritic processes	Intermediate cells of Billingham and Medawar (Group B)
Type	0"	DOPA (±)	cell having 5 dendritic processes	
Type	I	DOPA (−)	cell having 5 dendritic processes	*Langerhans' cell (Group C)
Type	II	DOPA (−)	cell having 4 dendritic processes	
Type	III	DOPA (−)	cell having 3 dendritic processes	
Type	IV	DOPA (−)	cell having 2 dendritic processes	

* The DOPA negative cells of group C bearing 5, 4, 3 and 2 dendritic processes respectively identified as Type I, II, III and IV Langerhans' cells, have already been examined by Shukla.[1,2] The characteristic features of this group is presented in Table II to demonstrate the intermediate nature of the Intermediate cells.

tion. a biometric and morphological classification of the DOPA positive dendritic cells of the epidermis of the black guinea-pig, having 5 to 8 dendritic processes,[3] is made to review the classification of the entire group of dendritic cells.

The pure epidermis preparation, obtained from the dorsal surface of the black ear of the black and white guinea-pig. is digested in a solution   of   3.4-dihydroxyphenylalanine   in normal saline according to the technique of

These cells, identified as above, are marked and then measured under the light microscope. Later, these slides are either partially demelanised in 10% H_2O_2 for 4 hours or fully demelanised for 8 hours and washed in running water for 15 minutes. Both are stained with hæmotoxylin and eosin, Masson-Fontana stain for melanin[6] and mounted in balsam after the usual process of dehydration and clearing. The result of the examination of these slides is presented in Table I.

TABLE I

The characteristic features of the ten types of the epidermal dendritic cells of the black guinea-pig

Group of dendritic cell		A (Melanocyte)			B (Intermediate cells)		
Type of dendritic cell	..	1	2	3	4	0'	0''
Number of dendritic processes	..	8	7	6	5	6	5
Response to DOPA	..	+	+	+	+	±	±
Cell characters :							
Shape	..	py	py	py	pe	he	pe
Total length (in μ)	..	65	65	60	55	50	50
Length of body (in μ)	..	15	15	12	10	10	10
Breadth of body (in μ)	..	10	10	10	10	10	10
Dendritic process characters:							
Breadth at root (in μ)	..	3	3	2	2	2	2
Breadth at tip (in μ)	..	3	3	3	3	2	2
Mode of branching	..	di	di	di	di	less di	less di
Nucleal characters :							
Shape	..	notched egg	notched egg	notched egg	notched egg	notched egg (irregularly)	oval
Size (length × breadth in μ)	..	12×6	12×6	11×6	11×5	10×5	10×5
Stainability with hæmatoxylin	..	+	+	+	+	+	+
Cytoplasm :							
Stainability with eosin	..	±	±	±	±	±	±

Py, pe, he, re, tr, fu and di indicate polygonal, pentagonal, hexagonal rectangular, triangular, fusiform and dichotomous respectively.

TABLE II

Characters of the melanocyte, intermediate cell and Langerhans group of dendritic cell of the epidermis of the black guinea-pig

		Melanoocyte group	Intermediate cell group	Langerhans' cell group
1. DOPA response	..	+	±	−
2. Shape	..	polygonal to pentagonal	pentagonal and hexagonal	pentagonal to fusiform
3. Size	..	65–55	50	46–35
4. Dendritic process number	..	8–5	5–6	5–2
Dichotomy	..	+	±	−
Breadth at tip	..	2	1	fine
5. Nucleus:				
Shape	..	notched egg	oval	shape of the body of cell
Size	..	12×6 to 11×5	10×5	10×5 to 9×4
Stainability with hæmatoxylin	..	+	+	+ +
6. Cytoplasm:				
Stainability with eosin	..	±	±	+
Nucleus/cytoplasm ratio	..	2/3	2/3	4/5

The group characters of the melanocyte, Intermediate cell and the Langerhans' cell are presented in Table II.

The study of Table II shows that the cells of the Intermediate group have characters which are intermediate between those of the melanocytes and the Langerhans' group of cells.

As the melanocytes examined here, as well as the group of Langerhans' cell possess dendritic processes, star-shaped bodies and a large single nucleus in the centre of each cell, they probably form one class of cells. The class, on biometric analysis, is shown to be divided into Type 1 to 4 melanocyte, Type 0' and 0'' Intermediate cell and Type I to IV Langerhans'

cell, each having a constant size. The constancy of the cell size of each group, following the Dreichets' Lam of Constant Volume of cells,[7] supports their classification into the above-mentioned types.

The study of Table I shows that this dendritic class of cells is headed by the melanocyte group, where the Type 1 melanocyte, being the largest cell with 8 dichotomously branched, blunt-tipped (Fig. 2, BT) dendritic processes (Fig. 1, DP) and a single, characteristically double-notched,[8] egg-shaped, basophilic nucleus (Fig. 13, EN) forms the first of the series and also the first of the melanocyte group. The Type IV Langerhans' cell (*loc. cit.*), being the smallest cell of

the dendritic series with two unbranched dendritic processes and a degenerating fusiform, deeply basophilic nucleus forms the last cell of the series. The dendritic processes of Type 2, 3 and 4 melanocyte, Type 0' and 0" Intermediate cell and Type I, II and III Langerhans' cell in order seem to undergo a gradual reduction in size[9] and number. It indicates that the cells bearing these processes in the order mentioned above form the intervening stages of senesece between Type 1

The melanin granules, which are exuberant in the melanocytes (Fig. 9, MG) are reduced in quantity in the Intermediate cell (Figs. 11 and 12) and became extinct in the Langerhans' cells.

The observations made here substantiate the hypothesis of Billingham and Medawar[12] that the melanocytes, after they had discharged their pigment, transform into Langerhans' cell through Intermediate cells.

Thanks are due to Shri R. K. Sarout and Shri R. K. Roy for their technical assistance.

FIGS. 1–18. Figs. 1–6 show some of the dendritic cells of the epidermis of the ear of the black guinea-pig after treatment with DOPA. Figs. 1–4 respectively show frankly DOPA positive, Types 1, 2, 3 and 4 melanocytes bearing 8, 7, 6 and 5 dichotomously branched (DP) and bulb-tipped (BT) dendritic processes. Figures 5 and 6 respectively show Type 0' and 0". Intermediate cells of Billingham and Medawar bearing 6 and 5, less dichotomously branched and bulb tipped (BT) dendritic processes. Figures 7 to 12 respectively show Types 1, 2, 3 and 4 melanocytes and Type 0' and 0" Intermediate cells of Billingham and Medawar after treatment with Masson Fontana stain. The dendritic processes and the bodies of the melanocytes are packed with melanin (MG). The Intermediate cells show lesser amount of melanin in the body of the cells. Figures 13–18 show Types 1, 2, 3 and 4 melanocytes and Type 0' and 0" Intermediate cells of Billingham and Medawar after treatment with Mayers' haem alum. Each of the melanocyte shows a vesicular, egg shaped (EN), basophilic and double-notched nucleus in the centre of the body of the cell, occupying 2/3 of the cytoplasm. The Intermediate cells of Billingham and Medawar show rounded or oval, basophilic nucleus filling nearly 4/5 of the body of the cell.

melanocyte and Type IV Langerhans' cell. This is further shown by the moderately basophilic, double-notched and egg-shaped nucleus of the melanocyte changing to the notch-less and oval form (Figs. 17, 18, ON) in the Intermediate cell, which gradually becomes more basophilic, shrunken and crenated[10] as it consecutively assumes pentangular, rectangular, triangular and fusiform shape, corresponding to the shape of their body in Type I to IV Langerhans' cell. The cytoplasm in the melanocyte, which is neutral in character and occupies nearly 1/3 of the space round the nucleus, as it is gradually reduced in quantity and changed to acidophilic[11] nature through the above-mentioned series of cells, shows the same phenomenon.

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LETTERS TO THE EDITOR

INFRARED SPECTRUM OF
p-BROMOANISOLE

THE vibrational spectral study of p-bromo-anisole has been made by a number of earlier workers.[1-4] Since none of them has presented the vibrational assignments for this compound, it was considered desirable to record the infra-red absorption spectrum and to make vibrational assignments.

The infrared absorption spectrum of p-bromo-anisole was recorded in liquid phase in the region 400–750 cm.$^{-1}$ on a Perkin-Elmer double beam infrared spectrophotometer (Model 21) with KBr prism using a cell of 0·10 mm. thickness and in the region 700–4600 cm.$^{-1}$ on a Perkin-Elmer spectrophotometer (Model 13 U) with NaCl prism using a cell of 0·05 mm. thickness. The accuracy of the measurement is estimated to be 2 cm.$^{-1}$ between 400–1500 cm.$^{-1}$, 4 cm.$^{-1}$ between 1500–3000 cm.$^{-1}$ and 10 cm.$^{-1}$ above 3000 cm.$^{-1}$

Assuming that the 'OCH$_3$' group behaves as a single particle, as has been done by many previous workers in the case of anisole and its derivatives, p-bromoanisole may be classified under C$_{2v}$ point group. But the number of polarized Raman lines suggest that the symmetry of this molecule is certainly lower than C$_{2v}$. Instead of having three elements of symmetry in C$_{2v}$, only one symmetry element is found (excluding identity), *i.e.*, plane of reflection. The normal modes of vibrations are divided into totally symmetric *a'* and non-totally symmetric *a''* species. All the vibrations are allowed in both Raman and infrared spectra. The species *a'* should give rise to polarized Raman lines and *a''* to depolarized Raman lines.

In assigning various modes of vibration assistance has been taken from the assignments of anisole[5,6] p-bromofluorobenzene[7] and other related molecules.

The assignments of the fundamental frequencies of p-bromoanisole have been given in Table I.

TABLE I

Fundamental vibrational frequencies (cm.$^{-1}$) and their assignments for p-bromoanisole

Infrared (liquid)		Assigned mode of vibration
cm.$^{-1}$	Int.	
3098	(5)	*a'* C—H stretching
3074	(4)	*a'* C—H stretching
3040	(8)	*a'* C—H stretching
2974	(9)	*a'* C—H asym. stretching (in methyl group)
2882	(7½)	*a'* C—H asym. stretching (in methyl group)
2833	(5)	*a'* C—H sym. stretching (in methyl group)
1594	(10)	*a'* C=C stretching
1567	(7)	*a'* C=C stretching
1487	(9½)	*a'* C=C stretching
1461	(10)	*a'* C—H asym. bending (in methyl group)
1444	(9½)	*a'* C—H asym. bending (in methyl group)
1409	(6)	*a'* C=C stretching
1383	(3)	*a'* C=C stretching
1294	(9*b*)	*a'* C—H sym. bending (in methyl group)
1288	(7)	*a'* C—H i.p. bending
1237	(9)	*a'* C—OCH$_3$ stretching
1168	(10)	*a'* C—H i.p. bending
1113	(7)	*a'* C—H i.p. bending
1102	(8½)	*a'* C—H i.p. bending
1073	(10)	*a'* C—C stretching (ring breathing)
1030	(10)	*a'* CH$_3$ rocking
1003	(9½)	*a'* C—C—C i.p. bending
950	(2½)	*a''* C—H o.p. bending
925	(2½)	*a''* C—H o.p. bending
816	(10*b*)	*a''* C—H o.p. bending
801	(9½*b*)	*a''* C—H o.p. bending
790	(2½)	*a'* O—CH$_3$ stretching
709	(5)	*a'* CH$_3$ wagging
695	(8)	*a''* C—C—C o.p. bending
629	(9½)	*a'* C—Br stretching
599	(10)	*a'* C—C—C i.p. bending
545	(5½)	*a'* C—OCH$_3$ i.p. bending
506	(10)	*a'* O—CH$_3$ i.p. bending
475*	(1)	*a'* C—C—C i.p. bending
416	(4½)	*a''* C—C—C o.p. bending
263*	(10)	*a''* C—Br i.p. bending
187*	(3)	*a''* C—OCH$_3$ o.p. bending
144*	(5)	*a''* C—Br o.p. bending

b = broad; i.p. = in-plane; o.p. = out of plane; sym = symmetric and asym. = asymmetric. * These values are taken from Raman data.

to use the infrared spectrophotometer in the region 400–750 cm.[-1], and to the C.S.I.R., New Delhi, for financial assistance.

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LATTICE EXPANSION OF MOLYBDENUM

ONLY two reports, one by Edward *et al.*[1] and the other by Ross and Hume-Rothery,[2] are available in literature on the temperature variation of the lattice parameter of molybdenum. Both have given the values of the lattice constant at different temperatures only above 800° C. and no systematic data are present below this temperature. The present paper gives the coefficient of thermal expansion of Mo from 28° C. to 522° C.

Specpure sample, obtained from John Matthey and Co., was annealed at 1200° C. for six hours. Powder pictures at six different temperatures were taken. The experimental technique and the method of evaluation of the lattice parameter employed were the same as described earlier.[3]

The variation of the lattice parameter with temperature was found to be non-linear. This could be expressed by the following relation obtained by a least-square treatment of the temperature-lattice constant data:

$$a = 3.14646 - 15.73 \times 10^{-6} (t-20) - 3.23 \times 10^{-9} (t-20)^2.$$

Here a and t are expressed in Å and °C. respectively. The temperature-dependence of the coefficient of expansion was obtained by differentiation of the above expression and was found to be given by

$$\alpha = 4.96 \times 10^{-6} - 20.5 \times 10^{-10} t.$$

In Fig. 1 the values of the lattice parameter, obtained by Edward *et al.*[1] and Ross and Hume-Rothery[2] and the author at different temperatures are plotted. This graph shows that the present values of the lattice constant at different temperatures and those reported by Edward *et al.*[1] and Ross and Hume-Rothery[2] lie on a smooth curve.

FIG. 1

Hidnert and Gero,[4] Worthing[5] and Nix and MacNair[6] are among those who determined the thermal expansion of molybdenum by macroscopic methods. The values of thermal expansion coefficient at room temperature obtained by them are 5.4×10^{-6}/° C., 5.0×10^{-6}/° C. and 5.2×10^{-6}/° C. respectively. These results are found to be in good agreement with the value obtained in the present investigation as 5.0×10^{-6}/° C.

Department of Physics,   RAM RAO PAWAR.
University College of Science,
Osmania University,
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ELECTRONIC ABSORPTION SPECTRUM OF *PARA*-METHOXYPHENOL IN VAPOUR PHASE

THE substitution of -OCH_3 and -OH radicals in *para* positions reduces the symmetry D_{6h} of benzene to C_{2v} in *para*-methoxyphenol and, therefore, has an allowed transition $A_1 \rightarrow B_1$.

The near ultra-violet absorption spectrum of this molecule in vapour phase was photographed on medium quartz spectrograph using path lengths of 25, 50 and 75 cm. over temperature range of 25° to 80° C. Hydrogen arc lamp served as a source of continuous radiation and iron arc furnished the comparison. The sample, p-methoxyphenol of highest grade, was obtained from Messrs. British Drug House, England.

The spectrum of this molecule lies in the region 3000–2825 Å. The strongest band at 2969·3 Å on the red side of the spectrum has been assigned as the 0, 0 band. Two ground state (124 and 241 cm.$^{-1}$) and five excited state (131, 496, 657, 809 and 1295 cm.$^{-1}$) fundamental vibrational frequencies have been identified. The remaining bands have been interpreted as due to overtones or combinations of these fundamentals. On the red side of most of the strong bands, satellites were observed with frequency separations of 21 and 91 cm.$^{-1}$, the latter being more pronounced. These bands can be interpreted as due to v–v transitions of some low-lying vibrations.

The ground state fundamental frequencies have been correlated with Raman[1] and infra-red[2] frequencies. The corresponding excited state fundamental frequencies and their probable mode of vibrations are shown in Table I.

TABLE I
Correlation of fundamental frequencies of para-methoxyphenol

Infra red[2]	Raman[1]	Ultra-violet absorption G.S.	Ultra-violet absorption E.S.	Mode of vibration
..	..	124	..	..
252	252 (2)	241	131	C-OCH_3 out of plane
640	640 (4)	..	496	a_1 component of e_{2g} (606) vibration of benzene
734	..	..	657	C·OCH_3 stretching
850	847 (8)	..	809	Ring breathing
..	..	..	1295	C-OH stretching or C–C stretching

G.S. = Ground state, E.S. = Excited state. Values in parentheses indicate the intensities.

The author expresses his thanks to Professor D. Sharma, University of Gorakhpur, for valuable guidance.

Department of Physics,   A. N. PATHAK.
Bhagalpur University,
Bhagalpur-7, *June* 13, 1967.

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DIELECTRIC PROPERTIES OF SOME ALDEHYDES AND KETONES AT 3 cm

USING the standing-wave technique, dielectric absorption studies have been carried out at 9214 Mc./s. at room temperature, $25 \pm 1°$ C., on the following aldehydes and ketones, in dilute solution in benzene except for crotonaldehyde. The dielectric constants at 1 Mc./s. and the refractive indices for the sodium D line of dilute solutions of these compounds in the same solvents have also been determined. The relaxation times τ and dipole moments μ have been evaluated from these measurements using the methods due to Gopalkrishna and Guggenheim.[1,2] The free energies of activation have also been calculated using Eyring's[3] equations by evaluating the frequency factors at the temperature of measurements.

The results of measurements and calculations are shown in Table I.

TABLE I

Molecule	Microwave τ in pico-seconds	Microwave μ in debyes	Radio-frequency μ in debyes	Activation energies in Kcal./mole E_τ	Activation energies in Kcal./mole E_η
Propionaldehyde ..	2·5	2·23	2·22	1·62	2·90
Acrolein ..	3·3	2·67	2·57	1·79	2·90
Crotonaldehyde (in carbon tetrachloride)	8·0	2·77	2·70	2·33	3·17
Furfural ..	7·8	3·36	3·61	2·30	2·90
p-Tolualdehyde ..	12·0	2·78	2·96	2·55	2·90
Cinnamaldehyde ..	12·5	2·71	3·35	2·58	2·90
Vanillin ..	13·0	2·25	2·68	2·60	2·90
Methyl-*n*-hexylketone ..	5·9	2·46	2·22	2·13	2·90
Ethyl-*n*-amylketone ..	5·8	2·44	2·43	2·12	2·90
Ethyl-*n*-hexylketone ..	5·5	2·48	2·41	2·09	2·90
p-Chloro-acetophenone	6·6	2·25	2·29	2·20	2·90
p-Bromo- ,,	8·1	2·10	2·79	2·32	2·90
p-Methyl- ,,	12·1	2·87	3·74	2·56	2·90
p-Methoxy- ,,	15·7	3·04	3·52	2·71	2·90

The accuracies in the dipole moments and in the relaxation times are estimated to be about 3% and 15–20% respectively.

The static and microwave values of dipole moments agree fairly well except for small divergencies in the case of molecules particularly with rather large dipole moments, such as p-methyl acetophenone. The higher moments obtained for unsaturated 'acrolein' and 'crotonaldehyde' compared to that of saturated 'propionaldehyde' seem to be due to the effect of conjugation[4] in the former.

The higher relaxation of 'crotonaldeyde' as compared to 'acrolein' may indicate that the heavier methyl substituent probably causes more hindrance to rotation in the former. The relaxation times of the aromatic ketones differ, and this will indicate that the rotation of the whole molecule rather than the group common to them leads to absorption.

The fact that the activation energies for dipole orientation E_τ are less than those for viscous flow E_η is in conformity with the established fact that the process of dipole orientation involving only rotation is easier for the molecule than the combined motion of rotation and translation involved in viscous flow.

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DETERMINATION OF H_2S PRODUCED BY SULPHATE REDUCING BACTERIA

ON using the chemical formula given in the ASTM method D 993–58 on "Tests for Sulphate Reducing Bacteria in Industrial Water and Water-formed Deposits",[1] it was observed that the sulphuretted hydrogen, calculated by this formula, gave very low values. The opalescence of the culture medium, formation of enough black ferrous sulphide and the strong smell of sulphuretted hydrogen in the culture medium of sulphate reducing bacteria under study, led me to check the formula given in the ASTM method.

It was found that the formula was incorrect and also it appeared to be rather complicated by the use of normality of both iodine and sodium thiosulphate solution.

Before applying the correct formula, my views were communicated to the Editor,

American Society for Testing and Materials, Philadelphia, U.S.A. The ASTM Sub-Committee considered the formula given by me as correct.[2]

The correct formula for determining sulphuretted hydrogen in ppm is therefore given below :

$$H_2S = (X_1-X_2) \times P \times 3408$$

where, $X_1 =$ cc of sodium thiosulphate that would react with a known volume of iodine solution, added.

$X_2 =$ cc of sodium thiosulphate solution that would react with the unreacted iodine (*i.e.*, cc of sodium thiosulphate used in back titration).

$P =$ Normality of sodium thiosulphate solution.

It would appear that whoever has made use of the ASTM formula has only reported 10% of the actual amount of H_2S produced in the culture medium. Such values of H_2S will be still valid provided they are multiplied ten times.

Defence Laboratory,   J. C. CHAUDHURI.*
Jodhpur, *April* 15, 1967.

*Present Address: Naval Chemical and Metallurgical Laboratory, Naval Dockyard, Bombay.
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SYNTHESIS OF 2-(2-FURYL) CHROMONES BY SELENIUM DIOXIDE OXIDATION OF FURFURYLIDENE CHALCONES

2-FURYL chromones have hitherto been prepared by three general methods : (*a*) the Baker-Venkataraman transformation starting from an appropriate o-hydroxy acetophenone by treatment with furoyl chloride[1]; (*b*) the thermal cyclisation between a phenol and an ethyl furoyl acetate[2] and (*c*) the conversion of a 2-(2-furyl) chromanone into the chromone by treatment with alkali.[3]

The conversion of a chromanone or a chalcone to the corresponding chromone by oxidation with selenium dioxide has first been reported by Venkataraman and co-workers[4] for the preparation of a number of flavone derivatives. Although this method forms one of the most widely-applied and important route to the synthesis of a chromone or flavone ring system, it has not been applied to heterocyclic chalcones with the exception of the chalcone, 1-(5-nitro

TABLE I

Aldehyde	Ketone	Chalcone		2-Fural chromone	
		M.P. (°C.)	Yield (%)	M.P. (°C.)	Yield (%)
Furfural	4-Benzyloxy resacetophenone	143	60	161	45
,,	2-Acetyl resorcinol 6-methyl ether	105	60	168	55
,,	4-Chloro-2-hydroxy acetophenone	104	60	205	55
,,	4-Acetamino-2-hydroxy acetophenone	175	60	205	55
,,	5-Acetamino-2-hydroxy acetophenone	193	60	225	55

pyrrolyl)-3-(o-hydroxyphenyl) propen-1-3-one, obtained from 5-nitro pyrrole 2-aldehyde and o-hydroxy acetophenone, from which the 2-pyrrolyl chromone was isolated by oxidation with selenium dioxide.[5]

The present communication deals with the application of the above synthetic method to the synthesis of a few 2-(2-furyl) chromones. Five 2-furylidene chalcones have been synthesised starting from furfural and 4-benzyloxy resaceto-phenone, 2-acetyl resorcinol 6-methyl ether, 4-acetamino-2-hydroxy acetophenone, 5-acet-amino-2-hydroxy acetophenone and 4-chloro-2-hydroxy acetophenone. The condensations were carried out in alcohol solution employing one molar proportion of 40–50% sodium hydroxide solution. These chalcones were oxidised employing 1:1 molar proportion of selenium dioxide in isoamyl alcohol medium by refluxing for about 3 hours and isolating the 2-furyl chromone from the residue after steam distillation to remove isoamyl alcohol and any unreacted 2-hydroxy acetophenone. The compounds prepared along with the yields and melting points are included in Table I.

Dept. of Chem.,   S. SUBHADRA KUMARI.
Osmania Univ.,   K. S. R. KRISHNA MOHAN RAO.
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TRANSFORMATION PRODUCTS OF CITRAL*

CITRAL is employed for the preparation of the widely used perfumes such as the ionones and methylionones.[1] In a recent communication[2] we have described the preparation of citral epoxide, an intermediate in the synthesis of (±) linalool.[3]

Conjugate addition of lithium methyl to citral† in the presence of cuprous iodide[4] furnished methyl citronellol‡ (I),

n_D^{27} 1·4475, $\nu_{max.}$ 2717, 1727, 833 cm.$^{-1}$
$\delta_{TMS}^{CCl_4}$ 1·07 (singlet, 6 H; gem dimethyl group), 1·61 and 1·68 (6 H; methyls on the isopropylidene group), 5·06 (1 H; vinyl proton) and 10·05 (triplet, 1 H; aldehyde proton)

which on sodium borohydride reduction in ethanol furnished methyl citronellol‡ (II)

$\nu_{max.}$ 3500, 1050 cm.$^{-1}$
as a pleasant smelling liquid.

$Me_2 C = CH . (CH_2)_2 . C(Me_2) . R$
(I) R $= - CH_2 . CHO$
(II) R $= - CH_2 . CH_2OH$

Reduction of citral† with iron and 50% acetic acid on steam bath in the presence of nickel chloride furnished citronellol and mixture of hydrocarbons[5] 2, 6-Dimethyl-2, *trans*-6-octadiene (III) and 2, 6-dimethyl-2, *cis*-6-octadiene (IV). Citronellol[6] was identified through its boiling point, refractive index, infra-red spectrum and comparison of its vapour phase chromatography behaviour with that of an authentic sample. The structure assigned to the hydrocarbon mixture (n_D^{23} 1·4450) is consistent with its refractive index and IR spectrum and has been confirmed by its conversion to levulinic acid on ozonolysis. Reduction of citral† with sodium borohydride in ethanol furnished a mixture of geraniol and nerol, free from citronellol. The mixture of geraniol and nerol so obtained was reduced with iron and aqueous acetic acid to a mixture of hydrocarbons III and IV having

an IR spectrum identical with that of the sample described above.

Geraniol on oxidation with dichlorodicyano-quinone[7] (D.D.Q.) furnisded citral.

$$Me_2C = CH.(CH_2)_2.\overset{\overset{\displaystyle Me}{|}}{\underset{\underset{\displaystyle OH}{|}}{C}}.R$$

(V) R = $CH_2 = CH \cdot CH_2$—
(VI) R = C_6H_5—
(VII) R = $C_6H_5 \cdot CH_2$—

The tertiary alcohols V‡ n_D^{25} 1·4615 VI‡, n_D^{25} 1·5160, and VII‡, n_D^{25} 1·5170 have been obtained in excellent yields by the action of allyl magnesium chloride, phenyl magnesium bromide and benzyl magnesium chloride respectively on methyl heptenone. The structures assigned for the tertiary alcohols are consistent with their IR and NMR spectra.

National Chemical Laboratory,　　　V. M. SATHE.
Poona-8, *June* 30, 1967.　　　　　A. S. RAO.

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STUDIES ON THE MECHANISM OF PRODUCTION OF PULMONARY OEDEMA

PULMONARY œdema in both laboratory and clinical practice is produced by a variety of conditions. It has been defined as a pathogenic state in which there is an abnormal extra-vascular water storage in the lungs. The filling of alveolar ducts and bronchus with fluid leads to the formation of froth. An understanding of the mechanism of pulmonary œdema is complicated by the diversity of conditions which produce it. Intravenous administration of adrenaline produces pulmonary œdema in several species of animals and this has been used as an experimental model for study of the mechanisms involved. Theoretically adrenaline injection may lead to pulmonary œdema by producing hæmodynamic change leading on to a disproportion between the working power of left and right ventricle, so that there is a greater accumulation of blood in the pulmonary area. Alternatively adrenaline may damage the capillary endothelium and thereby increase its permeability.[2,3] This may be a direct effect or may be due to release of certain toxic substances like histamine or 5–HT. Some of these possibilities were explored during the course of the present study.

In addition to clinical observations like appearance of frothy fluid from the nares the relationship of lung weight with total body weight, expressed as per cent value,[4] and one hour mortality have been adopted as criteria for assessment of the severity of the response.

Pulmonary œdema was produced by intravenous injections of adrenaline in the rabbit (2 mg /per animal). It was seen that pulmonary œdema was more severe in the winter months, the mortality rate was approximately 50% in the summer months, but rose to 100% in the winter. The mean lung body weight index in animals given adrenaline was $0·95 \pm 0·35$ with a mortality of 92%, whereas animals receiving noradrenaline to produce an equivalent hæmodynamic change had lung body weight index of $0·45 \pm 0·05$ with no mortality. The difference is statistically significant ($P = 0·001$).

The experiments were repeated with another monoamine namely 5-hydroxy tryptamine, which produces marked pulmonary hypertension, and also possesses positive ionotropic and chronotropic actiins on the heart[5]; again such injections failed to produce pulmonary œdema.

It would thus appear that hæmodynamic changes produced by adrenaline cannot be a major factor in production of pulmonary œdema in the rabbit in view of inability of noradrenaline or 5-HT to produce similar effects.

It has been suggested[4] that adrenaline damages capillaries and this action of adrenaline can be prevented by pretreatment of animals with nialamide [1-(2 benzyl carbamoyl) ethyl 2–iso-nicotinoyl hydrazine] a monoamine oxidase inhibitor. Acute administration of nialamide (5 mg./kg., 30 minutes before adrenaline injection) failed to influence production of pulmonary œdema by injections of adrenaline. However similar injections of nialamide given daily for

5 days prior to adrenaline challenge gave significant protection against pulmonary œdema formation $(P = 0.01)$.

It is possible that thrombo-embolic phenomenon may be superadded on capillary damage produced by adrenaline[4,5] and as such the effect of a known anticoagulant heparin was also studied. Animals received 5,000 units of heparin per kg. body weight 30 minutes before adrenaline injection. The lung body weight index of these animals were significantly lower than in untreated animals receiving similar injections of adrenaline.

In view of the above indirect evidences, it would appear that capillary damage produced by adrenaline with concomitant thromboembolic changes may possibly contribute to the production of pulmonary œdema.

Nialamide used in these experiments were kindly donated by Pfizer (India).

Department of Pharmacology,   ROMA UPPAL.
Maulana Azad Medical College,   P. SEN.
New Delhi-1 (India),   R. K. SANYAL.
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ON THE LARVICIDAL ACTION OF CRUDE CASHEWNUT SHELL OIL

CASHEWNUT shell oil is known to have insecticidal properties. Wats and Bharucha (1938) reported that the refined oil is lethal to the mosquito larvæ, *Armigeres obturbans*. In the preliminary tests conducted at the Medical College, Trivandrum, it has been seen that the larvæ of *Culex fatigans* Wied the vector of filariasis are highly susceptible to the toxic action of crude cashewnut shell oil. The crude form of the oil is an industrial waste in Kerala and it was therefore considered worthwhile to explore the possibility of using the crude oil for mosquito control in this State.

In an experiment, the lethal action of crude cashewnut oil obtained from a cashewnut factory in Quilon was compared with that of crude petroleum oil (Malariol). Three lots of 50 fourth instar larvæ of *C. fatigans* were released in 4 litres of water contained in enamel troughs measuring 18″ × 12″. The water in one trough was treated with Malariol at 1·5 c.c./sq. ft. and another with crude cashewnut shell oil at 0·25 c.c./sq. ft. The oils were applied to the surface of water in drops poured out from a dropper. The troughs were kept undisturbed after the application of the oils. The third trough, without any treatment, served as control. The experiment was replicated thrice. Mortality counts of the larvæ in the three sets were taken, 1 hour, 6 hours, 12 hours and 24 hours after treatment. The mean mortality rates of the three replications are given in Table I. It will be observed that even small quantity of crude cashewnut oil is considerably more effective than Malariol.

TABLE I

Per cent. mortality of larvæ of C. fatigans treated with crude petroleum oil and crude cashewnut shell oil

Treatment	% mortality			
	1 hr.	6 hr.	12 hr.	24 hr.
1. Crude petroleum oil ..	0	16	70	80
2. Crude cashewnut oil .	10	70	98	100
3. Control (No treatment)	0	0	0	0

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EFFECT OF SOLANACEOUS ALKALOIDS ON THE CONDITIONED AVOIDANCE RESPONSES IN TRAINED ANIMALS

RAY AND MARRAZZI[1] have reported that the well-known hallucinogen, lysergic acid diethylamide (LSD) blocks the conditioned avoidance responses in trained animals as does chlorpromazine.[2,3] Some similarities in the actions of LSD and atropine like mydriasis, rise in blood pressure, facial flush and hyperthermia have been described by Pfeiffer.[4] We have earlier reported that the solanaceous alkaloids (atropine, hyoscine and total alkaloids of *Datura*

alba) increase the 5-HT content of rat brain (Bose *et al.*, 1966)[5] as does LSD (Freedman,[6] 1961; Freedman and Giarman,[7] 1962). We now report on the effect of solanaceous alkaloids on the conditioned avoidance responses in trained rats.

The albino rats, weighing between 100–150 gm. were trained for the conditioned avoidance responses by the pole climbing[2] and jumping box techniques[8,9] in the usual way. In the former, the rats were trained to climb the pole when the buzzer was sounded for 5 seconds, while in the latter, they were trained to jump to the other part of the cage when the buzzer was sounded for the same duration. In case, they did not respond to buzzer, a mild electric shock was given. The animals had acquired the conditioned avoidance response (CAR), that is, they responded to buzzer only after 2 weeks training. The effect of drugs on the 'recently acquired CAR' was studied. Another group of rats continued to receive the training for 30–40 days and the effect of drugs on the 'overlearnt response' was studied.

TABLE I

Effect of drugs on the 'recently acquired CAR'

	Dose mg./kg.	Pole climbing technique percentage inhibition	Jumping box technique percentage inhibition
Atropine ..	100	40 (25)	48 (25)
Hyoscine ..	15	65 (20)	70 (20)
Total alkaloid of *Datura alba*	15	67 (15)	65 (15)
Chlorpromazine ..	3	75 (20)	80 (20)

The figures in parenthesis indicate the number of animals used in each experiment.

Chlorpromazine (3 mg./kg.), atropine (100 mg./kg.), hyoscine (15 mg./kg.) and total alkaloids of *Datura alba* (15 mg./kg.) were injected intra-peritoneally. The animals were tested for CAR 20–30 mts. after the administration of drugs as described earlier; if they did not respond to buzzer within 5 seconds, it was taken as impairment of CAR. Total alkaloids of *Datura alba* were extracted according to the B.P. (1963) method.[10]

Bradley[11] reported that atropine had no effect on the CAR by the above techniques. Our results (Table I) show that atropine impairs the 'recently acquired CAR' but has no effect on the 'overlearnt response'. Hyoscine and total alkaloids of *Datura alba* had similar actions,

but were more potent than atropine in impairing the CAR.

Dept. of Pharmacology,   B. C. BOSE.
M.G.M. Medical College,   M. A. MATIN.*
Indore (M.P.), India,   R. VIJAYVARGIYA.
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DUMORTIERITE FROM NEAR JAIPUR (RAJASTHAN)

DUMORTIERITE occurs in the quartzites of the Alwar series forty miles north-north-east of Jaipur near the village Deoan. The mineral is sometimes uniformly distributed in the rock and sometimes occurs in thin streaks, imparting a strong gneissic character to the rock.

The mineral dumortierite was separated from the rock by repeated centrifuging with heavy liquids. The mineral separate is very strongly coloured. The X-ray powder pattern of the mineral established its identity.

The optical data are:

$\gamma = 1 \cdot 695$.

$\gamma - a = 0 \cdot 017$ (determined with Berek compensator).

$a =$ deep blue, γ and β colourless.

$2 \nu_z =$ less than 15°.

Bxa sections are pseudo-uniaxial in character. Quite often the mineral occurs in the form of needles and is twinned on a prism face.

A chemical analysis of the mineral shows that it completely agrees with the formula $4[(AlFe)_7 BSi_3 O_{18}]$ given by Claringbull and Hey[1] (1958, p. 903) and also confirms their idea that water has no place in its structure. The oxidation state of titanium had been suggested

as Ti''' (Schaller, 1905[3]; Peck, 1926[2]) and it was
also contended that this condition of titanium
had a bearing on the colour of the dumortierite.
Claringbull and Hey discarded this suggestion
on the ground that adequate proof is lacking.
The silica content of most analysed dumortierites
fully satisfies the requirements of the formula
suggested and sometimes it is even in excess.
So it may be imagined that the titanium is
present as Ti''' replacing alumina. It is however
uncertain whether it has any bearing on the
colour of the mineral.

Other minerals present in the rock are, quartz,
muscovite, tourmaline, kyanite, sillimanite and
magnetite and a little zircon. Of all these
minerals only zircon is detrital and the rest
have no semblance of a detrital character, having
been developed during the metamorphism of
the quartzite. The original sediment must have
had a small clayey fraction from which the
aluminous silicates crystallised. Petrographic
evidence leads to the conclusion that
dumortierite developed at the expense of
kyanite and sillimanite by boron metasomatism.
A careful search of the area had not revealed
any major pegmatite body but small veins 2
to 4 cm. thick have been observed in the
dumortierite-bearing rocks. These small veins
could very well be offshoots of a hidden major
pegmatite body which could have supplied the
necessary boron for the dumortieritisation.

The varying colour and pleochroism, discussed
in earlier literature, was thought to be due to
the presence of titanium as Ti_2O_3 rather than
as TiO_2. However the authors feel that it is
in the presence of boron that sharp variations
in the titanium and Fe content produce the
different colours and pleochroism.

T. V. V. G. R. K. Murty.[*]
G. R. Amiladi.[**]
April 4, 1967.   G. N. Saxena.[‡]

* Centre of Advanced Study in Geology, University of
Saugar.

** Central Laboratories, A.C.C., Bombay.

‡ Department of Applied Geology, University of Saugar.

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A HAEMATOLOGICAL STUDY ON
MRIGAL, *CIRRHINA MRIGALA*
(HAMILTON)

The Mrigal, *Cirrhina mrigala,* is a fish of considerable importance both from the viewpoint of
riverine and culture fisheries. So far not much
work has been reported on its hæmatology and
other aspects of physiology. In fact only a few
accounts have appeared on the hæmatology of
Indian fishes. Dhar[1] has published a note on
the hæmatology of *Ophicephalus punctatus*.
Banerjee[2-4] has made some haematological
observations on *Heteropneustes fossilis* and
Anabas testudineus, while Pradhan[5] has
described the blood constituents of some Indian
fishes. The present note gives a brief account
of the morphology and size of erythrocytes,
erythrocyte and leucocyte counts, packed cell
volume, hæmoglobin content, erythrocyte
sedimentation rate and clotting time of the
blood of *Cirrhina mrigala*.

The blood samples were collected after
severing the tail of fishes as soon as they were
taken out from the University Fish Farm.
Heparin has been used as anticoagulin.

Packed cell volumes of 30 fishes were determined. The values ranged from 38·0% to
49·5% with a mean of 38·9%. PVC values
were found to be higher in males than in
females (Table I).

The erythrocyte counts showed a range of
1·93–2·69 million erythrocytes/mm.[3] and a mean
of 2·2 million. Like PCV, the erythrocyte
count was also high in males. Earlier workers
have also reported higher erythrocyte number
in males than the females.[4,5]

The erythrocytes are elliptical in shape with
centrally situated nuclei. The mean sizes of
erythrocytes and nuclei were $12·6\,\mu \times 6·9\,\mu$ and
$6·4\,\mu \times 2·8\,\mu$ respectively. Erythrocytes of males
and females were of the same sizes (Male:
$12·6\,\mu \times 6·9\,\mu$; Female: $12·7\,\mu \times 6·9\,\mu$).

Leucocyte counts made on 12 fishes ranged
from 6,200 to 8,200/mm.[3] with a mean
of 7,266. The total number of leucocytes were
low in Mrigal as compared to *O. punctatus*[1]
and *A. testudineus*[1] but higher than *Cyprinus
carpio*.[6]

Erythrocyte sedimentation rate was from
0·05 mm. to 0·4 mm. and the mean 0·186 mm.

Blood clotting time of 8 fishes determined by
0·5 mm. diameter capillary tubes in the month
of December ranged from 40 to 65 seconds with
a mean of 52·5 seconds. Clotting time was
found to be much higher in Mrigal than in

Packed cell volume (PCV), hæmoglobin, sedimentation rate (SR), and clotting time determinations: erythrocyte and leucocyte counts on Cirrhina mrigala
(number of fish in parentheses; range—R, mean—M)

	PCV (%)		Hæmoglobin (g.)		Erythrocyte (millions)		Leucocyte (thousands)		SR (mm.)		Clotting time (seconds)	
	R	M	R	M	R	M	R	M	R	M	R	M
Male and female combined	31·0–49·5	38·92 (36)	7·1–11·3	9·1 (36)	1·93–2·69	2·21 (36)	6·0–8·2	7·26 (12)	0·05–0·40	0·186 (23)	40–65	52·5 (8)
Male	31·0–44·0	39·9 (15)	7·8–10·6	9·23 (15)	1·93–2·64	2·33 (15)	6·0–8·2	6·91 (7)	0·08–0·30	0·167 (11)	40–44	42 (2)
Female	32·0–49·5	38·2 (21)	7·1–11·3	9·04 (21)	1·97–2·69	2·22 (21)	7·4–8·0	7·36 (5)	0·05–0·40	0·204 (12)	42–65	53·5 (6)

O. punctatus,[1] *H. fossilis,*[3] *A. testudineus*[4] and *Carassius auratus.*[7]

The hæmoglobin determined by Wong's[8] method ranged from 7·07 to 11·3 g./100 ml. of blood and the average hæmoglobin content was 9·116 g. The mean hæmoglobin content is high in males. The hæmoglobin range in other Indian fishes has been reported to be much higher than mrigal. Field *et al.*[6] reported a hæmoglobin mean of 10·5 g. in *C. carpio.*

Department of Zoology,   A. QAYYUM.
Aligarh Muslim University,   S. M. NASIM.
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OCCURRENCE OF ANTIMICROBIAL SUBSTANCE IN THE EXUDATE OF PHYSOGASTRIC QUEEN TERMITE, *TERMES REDEMANNI* WASMANN

IN an attempt to set up a colony of termites *Termes redemanni* Wasmann in our laboratory, different castes, namely workers, soldiers, their nymphs, drone and physogastric queen of the same colony, were brought from the mound and kept in 'standardized conditions'.[1] Incidentally it was observed that when the queen termite was removed from the rest of the colony, all the other members died of the attack of fungus *Aspergillus flavus.*

Frings *et al.*[2] showed that the blood of the large milkweed bug *Oncopeltus fasciatus* had an antimicrobial factor. In the honey-bees an antimicrobial substance was present in the royal jelly on which the larvæ feed.[3] Accordingly the blood and exudate of physogastric queen termite on which the other castes of termites feed, were tested for the antimicrobial properties. The blood and exudate were collected in separate vials and added to the media of cultures of *Aspergillus flavus.* The blood produced no effect while the exudate arrested the growth of the fungus, indicating the presence of antimicrobial factor in it.

To verify this assumption the following experiments were performed with two batches of termites. The first batch of termites was coated with queen exudate, while the other was uncoated. Both of them were rolled on the surface of the cultures of *Aspergillus flavus* and then kept in identical 'standardized conditions.' It was observed that the first batch was thriving well without being infected by the fungus while the other died of heavy fungal infection, in two days. This seemed to substantiate the earlier observation that an antimicrobial substance was present in the exudate of physogastric queen.

The exudate of queen termite was then analysed biochemically to find out the probable nature of the antimicrobial substance. The smears of exudate were intensely positive to Biuret, Periodic acid/Schiff and Sudan Black-B tests[4] indicating the presence of protein, carbohydrate and fat in it. That the exudate even after the removal of protein, by the chloroform-amylalcohol method,[5] still inhibited the growth of the fungus, might indicate that the protein fraction is not responsible for the antimicrobial property. The residue was active even after

precipitation and removel of carbohydrate with ethyl alcohol following method of Boas.[6] The lipid fraction of the residue was extracted with ethyl ether for 72 hours. Now the residue was inactive while the ether extract actively inhibited the growth of the fungus. This seemed to denote that the lipid component had the antimicrobial property. The ethered solution was extracted with 2 N potassium hydroxide and the alkaline extract was neutralized with 0·1 N sulphuric acid, after which the fatty acids were extracted with ethyl ether.[3] The extracted fatty acids were quite active and inhibited markedly the growth of *Escherchia coli*, *Micrococcus pyogenes*, *Neurospora sitapabia* and *Aspergillus flavus*, when added to the respective culture media.

Interesting and potentially useful properties of the antimicrobial substance in the exudate of physogastric queen were its tolerance to a wide range of pH, 4·3 to 8·1, and temperature as high as 75° to 80° C. did not destroy its effect.

It may be noted in this context that the nature and properties of the antimicrobial substance in the exudate of queen termite recall those of the antimicrobial substance in the royal jelly of honey-bees.[3]

The presence of antimicrobial substance in the exudate of queen termite is not surprising since the termites which favour high humidity, abundant moisture and low temperature[1] would otherwise be liable to be attacked by the harmful fungi like *Aspergillus flavus* which flourish well in such conditions.[7]

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Department of Zoology,   A. SANNASI.
Thiagarajar College,   G. SUNDARA RAJULU.
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NITRITE ASSIMILATION AT DIFFERENT pH LEVELS BY THREE IMPERFECT FUNGI

VARIOUS nutritional and biochemical studies have shown that the assimilation of nitrate nitrogen occurs after its stepwise reduction to ammonia,[3,6-10] the intermediate compounds in this reduction pathway being nitrite, hyponitrite and hydroxylamine.[5,14] Since nitrite is an intermediate product in the utilisation of nitrate, it would ordinarily be expected that organisms which utilise nitrates well should be able to utilise nitrites equally well, if not better. This, however, was not true in the present case. Using Asthana and Hawker's medium-A at pH 5·5 as the basal medium, the utilisation of nitrate nitrogen (*viz.*, nitrates of sodium, potassium, calcium and magnesium) by *Fusarium moniliforme* Sheldon, *Curvularia verruciformis* Agarwal and Sahni and *Sclerotium rolfsii* Saccardo, was good. When potassium nitrite was substituted as the sole nitrogen source, only *F. moniliforme* showed some growth while the other two fungi failed to germinate. This inability to grow on nitrite, whether total or partial, is believed to be due to the toxicity of undissociated nitrous acid occurring in nitrite media under acidic conditions.[2,3,11] An experiment was, therefore, set up to find out if this toxicity bore any relationship to the pH of the medium in the present case. Each of the three organisms was grown on potassium nitrite medium with its hydrogen-ion concentration adjusted at pH 4·5, 5·0, 5·5, 6·0, 6·5, 7·0 and 7·5. Four replicates were maintained for each of the above treatments.

Results (*see* Table I) showed that *S. rolfsii* is unable to grow on nitrite at any of the pH levels tried. *C. verruciformis* was observed to grow at pH 6·0, 6·5, 7·0 and 7·5, but not at pH 5·5 or below. *F. moniliforme*, on the other hand, showed growth at all the pH levels tried. The dry weight yields of *F. moniliforme* and *C. verruciformis* were found to increase when the initial pH of the medium was raised ; the highest yields being recorded at pH 7·0 and 7·5 respectively.

Since all three present fungi had shown ability to utilise nitrates well, it may be deduced that their failure to reduce nitrite nitrogen for utilisation could not have been due to an inherent lack of nitrite-reducing enzymes. The difficulty probably was in transporting the nitrite into the cells, for it is now a well-established fact that specific 'carrier' enzyme systems are required to transport organic

TABLE I
Response of three imperfect fungi on potassium nitrite medium at different initial pH levels

		Initial pH						
		4·5	5·0	5·5	6·0	6·5	7·0	7·5
F. moniliforme	Dry weight (mg.)	20	24	26	32	49	58	54
	Sporulation	P	P	P	M	M	G	G
	Final pH	7·0	7·6	7·8	7·9	8·1	8·6	8·3
C. verruciformis	Dry weight (mg.)	Nil	Nil	Nil	25	37	54	61
	Sporulation	..	..	..	P	M	G	G
	Final pH	..	..	..	7·5	8·0	8·4	8·2
S. rolfsii	Dry weight (mg.)	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Sclerotisation	..	..	..	..	..	..	..
	Final pH	..	..	..	..	..	..	..

P : Poor;   M : Moderate;   G : Good.

as well as inorganic solutes across living cell membranes.[1,4,5] *S. rolfsii*, which could not grow on nitrite at any of the pH levels tried, probably lacked the ability to transport the nitrite to the site inside the cell where it could be reduced and utilised. In *C. verruciformis* the nitrite-utilising ability, although present, was markedly sensitive to the pH of the medium, being inactivated at pH 5·5 or below. In *F. moniliforme* also the nitrite-utilising mechanism was noted to be sensitive to the pH of the medium, since growth decreased at lower pH levels. On the basis of the present experiments it cannot, however, be concluded whether this sensitivity was due to the toxicity of nitrous acid or simply due to pH variation which, if far enough from the optimum, may damage enzyme systems.[12] Where growth of the fungus on nitrite was observed the final pH of the media were found to have shifted to higher levels: the highest dry weight yields in one case (*F. moniliforme*) corresponding to the highest final pH recorded. This observation bears out the contention of some authors[13] that the ability of certain fungi to utilise nitrite is dependent on their ability to render the culture medium alkaline, after which better growth becomes possible.

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Department of Botany,   V. P. SAHNI.
Government Science College,
Jabalpur M.P. (India), *April 8, 1967.*

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NITROSO-GUANIDINE, A POTENT MUTAGEN IN BARLEY

AMONG the numerous chemicals possessing radio-mimetic properties, ethyl-methane-sulphonate, diethyl-sulphate and ethylene imine have been found to be the most potent mutagens in higher plants.[1-4] Another group of compounds such as N-nitroso methyl urea, N-nitroso ethyl urea and 1,4-bisdiazoacetylbutane have been classified by Rapoport as "supermutagens" in view of their higher mutagenic efficiency in relation to EMS and other chemicals.[5] N-Methyl-N'-nitro-N-nitroso-guanidine (NG) has been found to be a very efficient mutagen both in micro-organisms[6,7] and *Arabidopsis thaliana*[8,9] but has not been found to be effective in barley.[9]

During the course of a comparative study of a wide range of chemical mutagens, it was found that contrary to the suggestion of Ehrenberg and Gichner,[9] NG was as potent as EMS in barley. Dormant seeds of the barley variety NP.13 with a moisture content of 10% were treated with 0·005, 0·01 and 0·02%

aqueous solutions of NG (obtained from K and K Laboratories, U.S.A.). The seeds were pre-soaked in water for four hours and then treated with NG for 12 hours at 26° C. in conical flasks, subjected to intermittent shaking.

Germination was totally inhibited in 0·02% treatment. Data on seedling height in M_1 and chlorophyll mutation frequency in M_2 are given in Table I. Data from 0·3% EMS which gave seedling height reduction of 56% are included in Table I for comparison.[10]

TABLE I

Growth inhibition and mutation frequency induced by NG and EMS in barley

Treatment and dose		Height of 21-days old seedlings (% of control)	Number of M_2 families	Number of M_2 seedlings	Chlorophyll mutation frequency	
					% of M_2 families segregating	% of M_2 population
0		100	33	3300	0·0	0·0
NG	0·005%	98	24	8408	87·5	1·24
NG	0·01%	68	10	3979	100·0	0·70
EMS	0·3%	56	39	884	74·4	10·63

From the data, it is clear that NG may be a potent mutagen in barley and that if suitable dose and treatment conditions are standardised, it may even fall under the 'supermutagen' class of Rapoport.

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Division of Genetics,   M. V. R. PRASAD.
Indian Agri. Res. Inst., R. KRISHNASWAMI.
New Delhi-12,   M. S. SWAMINATHAN.
July 24, 1967.

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A NEW SPECIES OF *SHOREOXYLON*, *S. KRAUSELI* SP. NOV. FROM THE TERTIARY OF SOUTH INDIA

THE Cuddalore sandstones (Mio-Pliocene) of the South Arcot District, Madras, have yielded a large number of silicified woods belonging almost exclusively to various tropical dicotyledonous taxa. Of these the woods of Leguminosæ, Dipterocarpaceæ and Combretaceæ constitute the most commonly met with fossils.[1] The present communication records a new species of *Shoreoxylon* (Dipterocarpaceæ) from these sandstones showing remarkable affinities with two modern species of *Shorea*, viz., *S. talura* and *S. tumbuggaia*. The fossil has been collected from near Mortandra (Murttandichavadi) a few miles W.N. of Pondicherry.

The diagnostic features of the fossil wood are as follows:

Shoreoxylon krauseli sp. nov. (Figs. 1-3).— Wood diffuse porous. Seasonal growth indistinct, but concentric rows of resin canals simulate growth marks (Fig. 1). Vessels commonly solitary, often in radial groups of 2 or 3, 150–200 μ in tangential diam., 2-8 per sq. mm. Pits to vessels rounded to angular, alternate. Perforations simple, oblique. Vasicentric tracheids common. Fibres libriform, 15 μ in diam., non-septate, usually not aligned in regular radial rows. Xylem parenchyma abundant, both para and apotracheal; paratracheal scanty and vasicentric; apotracheal (1) as diffuse cells, (2) as very short, discontinuous, 1-3 seriate tangential strips at close intervals, and (3) as long tangential bands in concentric series with resin canals embedded (Fig. 2). Xylem rays 6-9 per mm., 2-5 seriate, mostly 3 or 4 seriate, 5-60 cells high (Fig. 3). Uniseriates rare, and very short. Ray tissue predominantly homogeneous, cells procumbent, ray splittings common. Resin canals vertical, in uniseriate, concentric rows, rounded to oval, 75-95 μ in diam.

The Type Specimen bearing the No. 98 is in the collection of C.G.K.R. at the Department of Botany, Osmania University, Hyderabad.

Among the fossil woods of Dipterocarpaceæ possessing resin canals in concentric seriations, viz., *Shoreoxylon, Dryobalanoxylon,* and *Hopeoxylon,* the present South Indian fossil agrees with *Shoreoxylon in toto*. This genus has so far been recorded in India from the Cuddalore sandstones of S. India, and the Middle Tertiary strata of Assam.

Comparisons of the fossil with the present-day members of the tribe Shoreæ have shown

its affinities with the genus *Shorea*. In the distributional pattern of xylem parenchyma and still seen in the moist deciduous forests of South India.[2]

FIGS. 1-3. Fig. 1. *Shoreoxylon krauseli* sp. nov. Polished transverse surface of the fossil to show the concentric rows of resin canals, × Nat. size. Fig. 2 Part of cross-section to show vessels, parenchyma and a tangential row of resin canals, × 45. Fig. 3 Tangential section showing the ray tissue, × 90.

the details of xylem ray tissue, the South Arcot fossil very closely agrees with the species of *S. talura* and *S. tumbuggaia*, both of which are

The fossil under record has been compared with the species of *Shoreoxylon* reported so far from India and abroad and found to differ

from all of them.[3] It thus merits the creation of a new species, and named as *Shoreoxylon krauseli,* the specific name being given in honour of late Prof. R. Kräusel of Frankfurt, W. Germany.

We are thankful to Prof. M. R. Suxena for his kind interest and encouragement.

Dept. of Botany,   C. G. K. RAMANUJAM.
Osmania University,   M. RAGHURAMA RAO.
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THE CYTOLOGY OF SORGHUM MACROCHAETA AND ITS POLYHAPLOID DERIVATIVE

Sorghum macrochaeta has been included under the section *Arundinacea* of the section *Eu-Sorghum.*[1] Plants of this species, grown out of the seed material secured from Dr. H. Doggett, Serere Research Station, Uganda, have been found to carry 40 chromosomes in the meiotic cells. While attempting to hybridise the natural tetraploid sorghums with diploids, in one of the crosses made, *S. macrochaeta,* has been used as seed parent. Six seeds have been obtained from this cross of which two germinated and one seedling survived to reach maturity. On cytological study, it is found to carry $2n = 20$ chromosomes. This plant resembled the seed parent closely, although it is distinctly taller. Presumably, it arose through parthenogenetic development of unfertilised egg of the seed parent, and therefore, designated as polyhaploid derivative from *S. macrochaeta* tetraploid.

Earlier, three polyhaploid plants of *S. halepense* (subsection *Halepensia*) have been described.[2-4] In all these reports the polyhaploid plants showed more or less regular meiotic behaviour suggesting that in *S. halepense,* there is predominantly one type of genome.

The present polyhaploid of *S. macrochaeta* is found to show irregular meiosis. At diakinesis 50% of the cells examined showed 2 to 4 univalents. At metaphase I, 2 to 8 univalents have been observed in 82% of the cells studied (Figs. 1 to 3 and 1a to 3a). Also, at this stage 232 bivalents are found to be rod type and 190 of ring type out of total of fifty cells analysed. The high frequency of univalent

formation and of rod type bivalents will bring about lower chiasma frequency than in any other normal diploid *sorghums* studied.[5] Actually, an average chiasma frequency of 12·24 per cell is obtained in polyhaploid (Figs. 1a to 3a). At anaphase I, only 5 out of the 25 cells examined, showed numerically regular distribution of chromosomes. In the remaining cells 1 to 8 lagging univalents were encountered. Also most of the univalents were either divided precociously or showed a tendency to do so (Figs. 4 and 4a). Pollen sterility was found to be 65-70% as judged by their stainability in acetocarmine.

FIGS. 1-4. Figs. 1-3. Metaphase I, in polyhaploid showing 2, 4 and 6 univalents respectively. Figs. 1a-3a. Explanatory diagrams of Figs. 1-3. Total chiasmata/Terminalised chiasmata are indicated alongside the figures. Fig. 4. Anaphase I, showing 7-6 distribution and 7 lagging univalents (4 already divided and formed daughter univalents). Fig. 4a. Explanatory diagram of Fig. 4.

In the tetraploid *S. macrochaeta,* quadrivalent formation varies from 2 to 7 in single cells with an average of 4·07, at diakinesis. The average chiasma frequency per cell at this stage is found to be 32·64 as against 15·10 in the polyhaploid. The former is greater than twice the chiasma frequency in polyhaploid plant. The higher frequency of univalent and rod-type bivalent formation and also the lower

chiasma frequency of the polyhaploid when compared to the tetraploid, *S. macrochaeta,* are considered consistent with the hypothesis, that the latter possess two semi-homologous genomes. The two genomes when present together, show homologous pairing and higher chiasma frequency. When the different genomes are present at the diploid level as in the polyhaploid reported here, they show reduced pairing affinity, as evidenced by high univalent formation and lower chiasma frequency. The tetraploid, *S. macrochaeta,* is therefore, considered as 'segmental allopolyploid'.

My sincere thanks are due to Professor J. Venkateswarlu for facilities and encouragement.

Department of Botany,   V. R. REDDI.
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INCREASED LEVEL OF INDOLE-3-ACETIC ACID OXIDASE INHIBITOR IN CROWN GALL TOBACCO TISSUE CULTURE STIMULATED WITH BEE BREAD EXTRACT

BEE bread extract (B), made by autoclaving of bee bread with water (2 g. per 20 ml.) and filtering, was shown to stimulate growth of *Nicotiana tabacum* L. and *Crotolaria spectabilis* L. crown gall tumour tissues cultured *in vitro.*[1] Experiments reported here revealed that B possibly affects an auxin metabolism in the former tissue.

Material.—Tobacco (*N. tabacum* L. var. White Burley) crown gall tumour tissue routinely cultured on a modified white's nutrient medium[1] with or without B (equivalent of 2 g. bee bread per 1 of the medium); the tissue was isolated in 1961. For tests on IAA-oxidase, 70 (M) and 120 (O) days old cultures were used.

Method.—250 mg. tissue samples were ground with 10 ml. of ice-chilled 0·1 M Na-phosphate buffer, pH 6·1. Homogenates were filtered and immediately processed. The oxidation of IAA was determined according to a manometric assay system.[2] Each flask contained 30 μM of IAA (1·0 ml.) in the side arm; 0·2 ml. of 15%

KOH and a wick of filter-paper in the centre cup; 1·0 ml. of 0·2 M Na-phosphate, pH 6·1, supplemented with 3 μM of $MnCl_2$ and 3 μM of 2, 4-dichlorophenol, and 1·0 ml. of the homogenate in the main compartment. The assay was conducted at 25° C. following 15 min. equilibration period.

Results.—Figure shows that the content of IAA-oxidase inhibitor (s) in the tissue cultured on a medium without B is small; there was no lag phase in the oxidation of IAA. In contrast, in 70 days old cultures stimulated with B the content of the inhibitor (s) was very high since in 75% of the explants the characteristic lag in oxygen uptake[2,3] of about 70 min. was recorded; in other 25% ones the lag lasted by about 2-5 hours. There was no similar lag in O_2 uptake in senesced 120 days old cultures (OB) showing a low rate of growth.

FIG. 1. Kinetics of IAA oxidation by homogenates of tobacco crown gall tumour tissue cultured on a medium without (M, O) or with bee bread extract (MB, OB). M and MB, 70 days old cultures; O and OB, 120 days old cultures. Oxygen uptake is expressed as μ l O_2 per 100 mg. fresh matter.

In vitro experiments revealed that there is a potent inhibitor (s) of IAA-oxidase in bee bread extract; it is thermostabile, dialysable. The lag in IAA oxidation induced by this inhibitor is shortened by riboflavin and light.[4] It seems that IAA-oxidase inhibitor present in B does not penetrate the cell membrane, since B in concentrations inhibitory for growth stimulated IAA-oxidase in whole seedlings and in excised hypocotyl segments of cucumber. Moreover, no IAA-oxidase inhibitor was found in *Crotolaria spectabilis* L. crown gall tumour tissue stimulated with B. Bee bread extract did

increase the level of IAA-oxidase in tobacco callus tissue.[4]

basis of above and other data[4] it is possible to suggest that B induces the of IAA-oxidase inhibitor (s) in crown gall tumour, cultured *in vitro*. possible that the increased growth in this stimulated with B follows in part the rate of destruction of endogenous

ciation is expressed to Professor Eike for a sample of 2, 4-dichlorophenol.

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OXIDATIVE METABOLISM OF CARBOHYDRATES IN PHYTOPHAGOUS INSECTS

1. Glycolysis in the Cotton Stainer, *Dysdercus fasciatus* Signoret (Pyrrhocoridae, Hemiptera)

OBSERVATIONS were carried out on the in *Dysdercus fasciatus* Sign., and it observed that for the efficient glycolysis the bug's system requires considerable amount of hexosediphosphate. In the of hexosediphosphate, glycolysis is considerably reduced presumably because of the of organic phosphate that is available the adenylate system in the presence of phosphorylating enzymes. Hexosediphosphate appears to act as a phosphate reservoir its presence the level of lactic acid because of the increased utilization of glucose. In the absence of hexosediphosphate, pyruvic acid increases the production of lactic acid to about the same level as obtained by hexosediphosphate alone. This increase in lactic acid is attributed solely to the activity of lactic dehydrogenase. In the absence of pyruvate, presumably sufficient amount of pyruvic acid is produced from the glycolysis of glucose and hexosediphosphate to saturate lactic dehydrogenase, making exogenous additions inconsequential.

It was also observed that neither whole homogenates nor the supernatants obtained from the centrifuged homogenates of *Dysdercus* were capable of glycolysing glucose in the absence of fluoride. The explanation may lie in the fact that soluble pyrophosphatase is inhibited by fluorides. No data, however, were collected in this behalf. It is contended, nevertheless, that inhibition of the pyrophosphatase by fluoride would decrease the rate of dephosphorylation simply on the basis of mass action, thus increasing the available pool of organic phosphate for phosphorylation.

Départment de Biologie, M. A. ALIKHAN.
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STOMATAL ONTOGENY IN *JASMINUM OFFICINALE* L.

THE stomata in members of the family have been described to be ranunculaceous and most commonly distributed on the lower surface of the leaf (*see* Metcalfe and Chalk[1]). This conclusion seems to have been based on a study of the mature leaves alone, and the developmental sequence has not been traced. As far as the author is aware, there is no other information on the ontogeny and structure of stomata in this family, and hence the present work on leaves of *Jasminum officinale* L. was undertaken. Majority of the stomata are anomocytic but occasionally they may be paracytic or they may possess only one subsidiary cell.

The development of different types of stomata is as follows. The stomatal meristemoids are trapezoidal or polygonal, scattered irregularly all over the leaf epidermis (Figs. 1, 2). Occasionally they occur in groups (Fig. 3). Each meristemoid is distinguishable from the

other cells of the epidermis by its granular cytoplasm, and a relatively larger nucleus. In anomocytic stomata, a meristemoid directly becomes a guard cell mother cell, without cutting off any subsidiary cells. It divides by a vertical wall forming two equal guard cells (Figs. 2, 6). Sometimes a meristemoid divides by an almost straight wall into two unequal cells, a small triangular cell and a large rectangular one (Fig. 4). Seldom both the cells may become guard cells (Fig. 5), or the

Occasionally the small triangular cell may divide by one more straight or slightly curved wall intersecting the first one to form a triad (Fig. 9) of which the central cell becomes guard cell mother cell. The latter develops into a stoma and the flanking cells into the subsidiary cells which become elongated in the direction of the long axis of the stomata. The stomata is now paracytic (Figs. 10, 11). The development of the paracytic stomata and the stomata with one subsidiary cell is mesogenous as the guard cells and the subsidiary cells develop from the same meristemoid.

Often the adjacent epidermal cells encircling the mature anomocytic stomata divide and assume the form of subsidiary cells. Thus they become perigenous (Fig. 12), sometimes the arrangement of the perigenes is such that they resemble the subsidiary cells of an anisocytic stomata (Fig. 13).

Although one frequently comes across groups of 2-3 stomata (Fig. 15), the occurrence of contiguous stomata is rare (Figs. 3, 14).

The presence of more than one kind of stomata on the same surface of the leaf has been reported earlier.[2-7]

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Department of Botany,   J. A. INAMDAR.
Sardar Patel University,
Vallabh Vidyanagar,
Gujarat. *April* 7, **1967.**

FIGS. 1-15. Figs. 1-2. Stomatal meristemoid (note division in Fig. 2). Fig. 3. Group of meristemoids. Fig. 4. Meristemoid after division. Figs. 5-6. Anomocytic stomata. Figs. 7-8. Stomata with one subsidiary cell. Figs. 9-10. Showing linear triads and tetrads respectively. (In Fig. 10 note perigenous stomata.) Fig. 11. Paracytic stomata. Figs 12-13. Perigenous stomata. Fig. 14. Contiguous stomata. Fig. 15. Two anomocytic stomata. Figs. 1-15. × 1,350.

large rectangular cell is transformed into a subsidiary cell whereas the small triangular one becomes a guard cell mother cell (Figs. 7, 8).

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REVIEWS AND NOTICES OF BOOKS

Augmented Plane Wave Method : *A Guide to Performing Electronic Structure Calculations.* By Terry Loucks. (W. A. Benjamin, Inc., One Park Ave New York, New York), 1967. Pp. xiv + 256. Price $ 7.50.

This lecture note and reprint volume provides instruction in the augmented plane wave method of calculating electronic structures. It is intended to supplement courses in the theory of solid state physics on the senior and graduate level.

The subject is presented in three stages so that readers with a variety of background and interests may find the information they need. Included are detailed explanations of the formalism, numerical aspects, and the various techniques required to prepare the input parameters in the calculations. A complete set of all the computer programs required to perform APW calculations, with detailed explanations of the input and output variables, is also included. The book is written in language any physical scientist can understand, and the only prerequisite knowledge is some background in quantum mechanics and the Bloch theory of electrons from solid state physics.

The collection of reprints which concludes this volume contains important original papers in the field plus several recent applications demonstrating the technique.   C. V. R.

Dover Publications, Inc., 180, Varick Street, New York :

1. An Introduction to Fluvial Hydraulics. By Serge Leliavsky. Pp. xii + 257. Price $ 2.00.

This Dover edition, first published in 1966, is an unabridged and unaltered republication of the second corrected impression (1959) of the work originally published by Constable and Company, Ltd., in 1955.

The contents of this book are : List of Symbols ; Two Alternative Approaches to the Sediment Transportation Problem ; Difference between Traction and Suspension ; Correlation between Surface Slope and Particle Size ; Dunes and Ripples ; Basic Scour Criteria : Pick-Up Velocity, Drag and Lift ; Bed-Load according to the Drag Theory and Other Methods ; Side-Slope Stability in the Light of the Drag Theory ; Three-Dimensional Characteristics of the

Water Flow in Rivers and the Non-Parallelism Principle ; Sediment Suspension Explained Mechanically ; The Empirical Approach to the Sediment Transportation Problem.   C. V. R.

2. Infinite Matrices and Sequence Spaces. By Richard G. Cooke. Pp. xiii + 347. Price $ 2.50.

This book first published in 1955 is an unabridged and unaltered republication of the work first published by Macmillan and Co., Ltd., in 1950. The titles of the chapters are given below : Definitions and Preliminary Ideas ; Reciprocals of Infinite Matrices ; Linear Equations in Infinite Matrices ; Divergent Sequences and Series ; Consistency, Mutual Consistency, and Absolute Equivalence ; The Core of a Sequence ; The Inefficiency Problem for Infinite Matrices ; The Efficiency Problem for Infinite Matrices ; Hilbert Vector Space and Hilbert Matrices ; Projective and Distance Convergence and Limit in Sequence Spaces.   C. V. R.

International Review of Cytology (Vol. 20). Edited by G. H. Bourne and J. F. Danielli. (Academic Press, New York and London), 1966. Pp. xvi + 380. Price $ 17.00.

Volume 20 of this well-known series contains the following articles : 1. The Chemical Organization of the Plasma Membrane of Animal Cells, by A. H. Maddy ; 2. Subunits of Chloroplast Structure and Quantum Conversion in Photosynthesis, by Roderic B. Park ; 3. Control of Chloroplast Structure by Light, by Lester Packer and Paul-Andre Siegenthaler ; 4. The Role of Potassium and Sodium Ions as Studied in Mammalian Brain, by H. Hillman ; 5. Triggering of Ovulation by Coitus in the Rat, by Claude Aron, Gitta Asch, and Jacqueline Roos ; 6. Cytology and Cytophysiology of Non-Melanophore Pigment Cells, by Joseph T. Bagnara ; 7. The Fine Structure and Histochemistry of Prostatic Glands in Relation to Sex Hormones, by David Brandes ; 8. Cerebellar Enzymology, by Lucie Arvy.   C. V. R.

Recent Progress in Hormone Research (Vol. 22). Edited by Gregory Pincus. (Academic Press, New York and London), 1966. Pp. viii + 593. Price $ 25.00.

The 1965 Laurentian Hormone Conference met during the period August 29 to September 3

at the Mont Tremblant Loge in Mont Tremblant, Quebec. The papers delivered at that meeting are published in this book and their titles are as follows: I. PROTEIN HORMONES: 1. Interactions of Metabolism and the Physiological Role of Insulin; 2. The Growth-Promoting and Anti-Insulin Actions of Somatotropin; 3. Parathyroid Hormone: Chemical Properties and Structural Requirements for Biological and Immunological Activity; II. COMPARATIVE ENDOCRINOLOGY: 4. The Prostaglandins; 5. Environmental and Neuro-endocrine Regulation of Annual Gonadal Cycles and Migratory Behavior in Birds; III. STEROID HORMONES: 6. Studies on Leydig Cell Physiology and Pathology: Secretion and Metabolism of Testosterone; 7. Recent Studies in Steroid Hormone Metabolism in Man; 8. Biological Effects of Synthetic Gonanes; 9. Hormones and Breast Cancer; 10. Mechanisms Regulating Adrenocortical Secretion of Aldosterone and Glucocorticoids; IV. MODE OF HORMONE ACTION: 11. Studies on the Mode of Action of Aldosterone; 12. Ecdysone, an Insect Steroid Hormone, and Its Mode of Action; V. HORMONES AND DEVELOPMENT: 13. Modifications in the CNS Regulation of Reproduction after Exposure of Prepubertal Rats to Steroid Hormone; 14. Problems of Fetal Endocrinology: the Adrenal Glands.

C. V. R.

Soil Productivity and Crop Growth. By P. C. Raheja. (Asia Publishing House), 1966. Pp. xv + 474. Price Rs. 35·00.

Soil, the chief resource of farmers, is the basis of national wealth. In recent years problems of soil productivity and crop growth have attracted much attention because of the alarmingly low yields of crops in India and measures are being adopted to step up their produce. This book deals with Indian soils, their characteristics and fertility status; crop production in relation to nitrogen, phosphate, potash and micronutrients; soil amendments and secondary elements; growth of crops; plant growth factors; and yield analysis.

This volume will serve as a reference for research workers in Agronomy, Soil Scientists and Plant Physiologists, Specialists in Soil Management and Crop Husbandry, and Fertilizer Technologists will also find it a useful guide.

C. V. R.

Recent Developments in Particle Physics (*Nuclear Physics,* Vol. 3). Edited by Michael J. Moravcsik. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1966. Pp. 263. Price $ 15.00.

The present volume forms the third in the Series of Monographs and Texts in High-Energy and Low-Energy Nuclear Physics edited by L. Lederman. It contains the series of lectures delivered at the First Pacific International Summer School in Physics held in Honolulu in August 1965. The contents are as follows: Particles and Cross-Sections in a Theory of Local Observables by Rudolf Haag; Spontaneous Symmetry Breaking and Related Problems by Hironari Miyazawa; The Algebraic Description of Hadron Matter and its Observational Implications by Yuval Ne'eman; Lectures on Bootstraps by F. Zachariasen; The Bootstrap Theory of Symmetry Breaking by Steven Frautschi; The Non-Dynamical Structure of Particle Reactions by Michael J. Moravcsik.

A. S. G.

Books Received

Fundamental University Physics. By Alonso-Finn. (Addison-Wesley Publishing Co., London W 1). I. Mechanics: Pp. xvi + 435. Price $ 8.75 ; *II. Fields and Waves :* Pp. xvii + 438–965. Price $ 8.75.

Engineering Mechanics (Vol. *I : Statics*). By T. C. Huang. (Addison Wesley Publishing Co., London W. 1), 1966. Pp. xi + 419.

Basic Microscope Technics. By Ruth McClung Jones. (The University of Chicago Press, Chicago, Illinois 60637), 1966. Pp. xiv + 334. Price $ 6.50.

Recent Developments in Particle Physics (Vol. 3). Edited by M. J. Moravcsik (Gordon and Breach, New York), 1967. Pp. 263. Price $ 15.00.

Royal Institute of Chemistry Symposium— Chemistry, Medicine and Nutrition. (Royal Institution of Chemistry, London W. C. 1), 1967. Pp. iv +127. Price 21 *sh.*

Introduction to the Theory and Practice of High Vacuum Technology. By L. Ward and J. P. Bunn. (Butterworth and Co., London), 1967. Pp. vii + 216. Price 48 *sh.*

Advances in Inorganic Chemistry and Radiochemistry (Vol. 9). Edited by H. J. Emeleus and A. G. Sharpe. (Academic Press, New York), 1967. Pp. xv + 386. Price $ 15.58.

THE EFFECTS OF DEUTERIUM ON LIVING ORGANISMS

PYARI MOHAN MISRA

Ravenshaw College, Cuttack, Orissa

INTRODUCTION

THE effect of deuterium on living organisms has been investigated intensively after its discovery by Urey et al. (1932). When heavy water is used in biological experiments, it provides the stable isotope deuterium which replaces hydrogen in biological systems. The effect of deuterium has been studied by several research workers among whom are Barnes (1933, 1934); Lewis (1933, 1934); Taylor et al. (1933); Harvey (1934); Mayer (1934); Richards (1933, 1934); Strain et al. (1960); Giovanni (1960); Czajka and Finkel (1960); Gross and Spindel (1960); Lester et al. (1960); and Konard (1960). Experiments were conducted with bacteria, fungi, algæ, higher plants, protozoa, fishes, frogs and mice in heavy water in the range of 40 to 100% and it was found out that high concentration of deuterium was not suitable for growth. That dilute solution of deuterium may stimulate growth has been advocated by Barnes (1933), Richards (1933, 1934) and Meyer (1934), but Fox et al. (1936), Misra (1963) observed that growth was retarded even in dilute deuterium. Ewart (1935) and Weiser (1937) reported that dilute deuterium was indifferent to growth.

DEUTERIUM EFFECTS ON ANIMALS

High concentrations of deuterium have not been found to be favourable for growth of many organisms because specific metabolic functions have been adversely affected. Taylor et al. (1933) reported that Paramecium caudatum was killed by 92% D_2O within 48 hours, but 15–20% D_2O did not affect the organisms for three days. In addition, they found that although the flatworm, Planaria maculata, died within three hours in 92% heavy water, it could not be placed in 30% heavy water for about three days without injury. Harvey (1934) observed that protozoa (Amœba dubia and Epistylis infusorian) and rotifers (Monostyla bulba and Philodina roseola) were killed in 48 hours in 85–90% heavy water. He observed that 85–90% D_2O killed Paramecium in 24 hours, but in 100% D_2O death occurred in six to ten hours. In 97% D_2O Euglena gracilis remained motionless for eight hours. On the ninth day the D_2O was replaced by distilled water, and most of the euglenæ recovered and swarmed normally. Barnes and Gaw (1936) observed that the contractile vacuoles of Paramecium caudatum emptied in 11·3 seconds in ordinary water, while the same phenomenon occurred in 18·9 seconds in 30% D_2O at 18·8° C. Delamater (1936) showed that in 98% D_2O the protozoan, Uroleptus mobilis, died in a few hours, whereas in a concentration of 48·1%, the rate of contraction of the contractile vacuole, the rate of fission, and the longevity of the organism were reduced. Crespi et al. (1960) cultured Paramecium caudatum in 60% D_2O, passing the animal through the following concentrations: 0, 44, 55 and 60% D_2O. Neither major abnormalities in the structure of the cells nor in their growth were noticed at D_2O concentrations below 60%. However, in 60% D_2O, the cell numbers increased for about two weeks and monster forms appeared in the culture. Growth occurred when the D_2O cincentration was raised to 65 or to 70%.

Gross and Spindel (1960 a) studied the antimitotic effect of D_2O by putting the eggs of the sea urchin, Arbacia punctulata, in these concentrations of D_2O: 1, 12·5, 20, 50 and 70%. In eggs grown in 12·5% D_2O they found no alternation in the kinetics of division, but cleavage was delayed for 12 to 15 minutes, and the larvæ produced were similar to those grown in the control. In eggs grown in 25% D_2O, delay in first cleavage was much longer than in the 12·5% sample. These eggs divided slowly and the larvæ produced were similar to normal larvæ although they showed some lag in development. Eggs grown in 50% D_2O exhibited additional abnormalities during cleavage. About 25% of the cells did not divide at all, and 50% divided very slowly and irregularly. Hence, in 50% D_2O there were 25% undivided eggs, 25% showing the two-celled stage, and 50% showing irregular multicellular division, producing no free-swimming larvæ. In 75% D_2O most of the cells died before they divided. Gross and Spindel (1960 a) obtained similar results with the eggs of the annelid, Chœtopterus pergamentaceus, using the above concentrations of D_2O,

Taylor et al. (1933) reported that the common guppy, *Lebistes reticulatus*, was killed within two hours after being placed in 92% D_2O, but 30% D_2O had no effect for a period of 24 hours. Macht and Davis (1934) found no change in the behaviour of the goldfish, *Carassius auratus*, in 0·05% D_2O. Hevesy and Hofer (1934) measured the exchange of water between the goldfish, *C. auratus*, and its surroundings using 0·05 mole per cent. D_2O (approximately 5·8% by weight of D_2O) as an indicator. They found that in the goldfish, all the water molecules in the body were replaced in a few hours by water molecules derived from the surrounding water. Krogh and Ussing (1937) studied the permeability of trout eggs to D_2O and reported that D_2O did not enter newly fertilized eggs but passed slowly through the older eggs. The impermeability of newly fertilized eggs to D_2O lasted for some days, the eggs becoming permeable when the eyes were visible in the embryos. However, oxygen passed into the newly fertilized eggs even though water and salts were not exchanged. Barbour and Bagdanovitch (1937) studied the effect of D_2O of various concentrations ranging from 10 to 100% on isolated melanophores of *Fundulus heteroclitus*. The melanophores contracted in all concentrations above 10% and reverted to normal when returned to normal water. These authors then tried to determine whether the sympathetic nervous system was involved in this operation. Scales were ergotized with epinephrine ethansulfonate or ergotamine tartarate. Although ergotized melanophores did not contract in D_2O up to 20% they contracted slightly in more than 25% D_2O. It was shown that D_2O was a sympathetic stimulant. Prescott (1955) measured the permeability of salmon eggs, using 15% D_2O and a cartesian diver balance, and found that the eggs were slightly water-permeable. However, 25 minutes after activation they became completely impermeable. The chorion was freely permeable to water and the impermeability may have been due to the precipitation of the lipoprotein at the yolk surface.

Barnes and Warren (1935) showed that the beating of isolated frog heart was decreased by 50 to 75% in a 20% D_2O Ringer's solution as compared with Ringer's solution prepared from ordinary water. Ussing (1935) studied the effect of heavy water on the rate of segmentation of frog eggs (*Rana platyrrhina*) at 18–19° C. He found that 5% D_2O had no effect. At 10% D_2O there was a slight retardation, but it was not significant. In 20 and 25% D_2O the first cleavage was retarded by 8 and 17 minutes respectively. When concentrations higher than 30% D_2O were used, the first segmentation became irregular and divided the egg into more than two parts. The development of the egg stopped at the first or second segmentation at concentration higher than 25% D_2O. Eggs of the toad, *Bufo viridis*, were kept for some time in ordinary water and were then transferred to 10, 30 and 40% D_2O. They developed for 24 hours at the same rate as the controls in ordinary water. However, the eggs in 30 to 40% D_2O died, while the eggs in 10% D_2O developed normally and hatched after four days. When the oxygen consumption of the eggs of *Bufo viridis* grown in 30% D_2O at 19° C. was determined, the results suggested that oxygen consumption was the same for the first 14 hours and then decreased gradually to zero, death ensuing.

Many experiments have been conducted to show the lethal effects of deuterium on mice. Barbour (1935) indicated that the basal metabolism of mice was decreased by subcutaneous injection of 99% deuterium. Barbour and Trace (1936) described the physiological effects of deuterium on white mice using 40 to 99·5% D_2O. When 1 ml. of 99·5% D_2O per 10 g. of body weight per day was given, the metabolism decreased during the fourth day. On the fifth day, jumping reflexes appeared and the temperature of the mice fell. On the seventh day, with the body saturated with 40 to 50% D_2O, the animal died. The metabolism was about one-fifth of the normal level before death. Control mice similarly showed decreased temperature and lowered metabolism about two days later than the deuterated mice, but no jumping reflexes were seen. From other experiments, it was found that the amount of D_2O administered was more significant than the concentration or the time period of administration. In the same investigation, it was observed that urine flow decreased and that the body retained water abnormally on the first day that D_2O from 40 to 99·5% was given. Water retention was probably due to the upset of glomerular filtration caused by the high viscosity of the D_2O. Barbour and Rice (1937) found that four mice, given 40% deuterium in the dosage of 1 ml. per 10 g. of body weight per day, exhibited an increase of 30% over the standard six-hour metabolism

beginning from the fifth to the tenth day of D_2O administration. Barbour and Herrmann (1938) observed that 20% deuterium, when administered to the mice, resulted in one-fifth saturation of the body water with deuterium and produced sympathetic action, such as exophthalmus. Similar effects can be produced by injecting epinephrine in the dosage of 0·1 mg. per 10 g. of body weight, or by mechanically exciting the animal. However, the effect of deuterium lasts for a much longer period than epinephrine. Thomson (1960) investigated the physiological effects of deuterium on rats using concentrations of 50 and 100%. A slight loss in weight was noticed on the first day. In about ten days when 15% of the body water was replaced by deuterium, the animals showed hyperactivity. When 20 to 25% of the body water was replaced by D_2O, the rats became hyperexcitable; and at 30% replacement, their body weight decreased, and the animals died from respiratory depression. During this period, the liver increased by 50% in weight, when considered as per cent. of total body weight, and the adrenal glands increased by 60% in weight. In whole blood or plasma there was a steady increase in non-protein nitrogen and urea, and a decrease in glucose and plasma protein. The increase of blood urea nitrogen may have been due to an increased production or to a decreased renal function. The animals became anæmic and the number of erythrocytes decreased to 40% of the normal level. In addition, the number of lymphocytes and granulocytes decreased in the blood. The blood glucose level increased more than 50% in normal rats 30 minutes after deuterium injection, but within five hours decreased to 25% below normal. After two days there was still a low level of blood glucose, and liver glycogen was completely absent. In the deuterated rats, a 35% decrease in the activity of DPN-cytochrome C-reductase was seen. The toxicity of D_2O was due to small changes in rates of enzymatic reactions of the body. Hypophysectomized rats were more sensitive to D_2O than were normal rats and died when the blood plasma deuterium level was less than 20%. Hughes et al. (1960) claimed that Swiss mice became sterile when 30% D_2O was given in the drinking water. The development of eggs in a female mated with a D_2O-treated male was abnormal. This was due to abnormal changes in the genetic material of the developing sperm. Czajka and Finkel (1960) obtained a similar reduction in the reproductive

potential of female mice when 25% D_2O was given in the drinking water.

Rothstein et al. (1960) studied the effects of D_2O on cellular components of mammalian cells, grown in tissue culture using 20% D_2O, and found enlargements of cells resembling giant cells produced by irradiation. Robinowitz et al. (1960) reported that mammalian cells in tissue culture media containing 25 to 50% D_2O not only became enlarged and vacuolated but were also accompanied by some nuclear degeneration and changes in the mitochondrial distribution of the cytoplasm. Liver homogenates of D_2O-fed mice gradually lost the ability to convert acetate -2-C-14 to cholesterol and fatty acid. Mouse livers showed a remarkable increase of cholesterol and fatty acid biosynthetic capacity when incubated in 75% D_2O. The reduced lipogenesis in D_2O-fed mice was due to disorders of the cell structure and not to the inhibition of enzyme activity.

Fischer (1936) found that mouse carcinoma cells did not grow in the presence of more than 50% D_2O. In 70% D_2O he observed proteolytic degradation of the plasma clot and reduction of cell growth in Rouse fowl sarcoma. Finkel and Czajka (1960) reported that the growth of Krebs-2 A ascites tumors in mice was checked significantly when the concentration of deuterium was 13 to 23% in the body fluids. They found that when the concentration of deuterium was increased, the glutamic oxalacetic transaminase level was also elevated in the serum, and was significantly raised in the ascitic plasma. Hence, deuteration injured the tumor cells which in turn released glutamic oxalacetic transaminase into the blood. They found no significant difference in the mitosis of deuterated and non-deuterated tumor cells, they reasoned that this partly supported the hypothesis that D_2O destroyed mouse ascites tumor cells.

DEUTERIUM EFFECTS ON PLANTS

Taylor and Harvey (1934) noticed a decrease in the rate of respiration in yeast cells subjected to deuterium concentrations above 20%. Respiration dropped to 50% of the normal value in 97% D_2O. Taylor (1934) found that the sugar concentration in yeast grown in 85% D_2O was only one-ninth of the value obtained in normal water. Pratt (1936) studied the effects of D_2O, ranging from 0·02 to 100%, on the germ tube elongation of the fungus, *Erysiphe graminis*. Spore germination occurred in all concentrations, but the elongation of the germ

tubes was strikingly inhibited by higher concentrations. The total length attained by the germ tubes and the maximum rate of elongation were inversely proportional to the concentration of D_2O. Chance and Allen (1946) reported that the gross morphology of the bacterium, *Eberthella typhosa*, was changed in 8% D_2O, but was reversible to the normal condition when the organism was placed in ordinary water. Crumley and Meyer (1950) claimed that the germination rate of the spores of the mold, *Ustilago nigra*, grown in 0 to 100% was retarded as a function of D_2O concentration, but the total germination was only slightly affected. Crespi *et al.* (1960) cultured *Escherichia coli* (K-12), the yeast, *Torulopsis utilis*, and the fungus *Aspergillus niger*, in 100% D_2O. Giovanni (1960) reported that the growth of several strains of *E. coli* and *Bacillus subtilis* was inhibited by the presence of deuterium and found that the growth response of each strain was specific. The inhibition was decreased when the concentration of D_2O in the medium was reduced. Not a single strain grew well at concentrations above 80% D_2O and most were not inhibited by concentrations below 50% D_2O. The inhibition of growth was decreased by the addition of 0·5% sodium chloride to D_2O media. Deuterium led to phenotypic and genotypic changes in the micro-organisms and mutations were obtained in some of the bacterial strains. Lester *et al.* (1960) studied the effect of D_2O on bacterial growth and found that *Myobacterium tuberculosis* growth was reduced when the deuterium concentration was more than 80 atom per cent. Concentrations between 25 to 80 atom per cent stimulated growth slightly after 21 days of incubation. Konrad (1960) investigated the effect of D_2O on the bacteriophage T_4, and found a mutagenic effect of D_2O. Manson *et al.* (1960) experimented with the effect of D_2O on virus-host interaction and claimed that higher D_2O concentrations led to an increase in the number of multi-nucleated cells and a moderate increase in sudanophilic material. Cells grown in D_2O resembled giant cells produced by irradiation.

Craig and Trelease (1937) reported that the photosynthesis of *Chlorella* was significantly depressed in D_2O. Pratt (1938) found that the growth did not occur in concentrations above 75%. Strain *et al.* (1960) isolated deuterated chlorophylls *a* and *b* from the chloroplasts of *Chlorella vulgaris* and *Scendesmus obliquus* grown in 99·8% D_2O for more than a year.

These workers also made preliminary observations on the photosynthesis of the above two algæ and reported that there was very little difference in the rate of photosynthesis in the presence of D_2O or H_2O. Conrad and Katz (1960) found that deuterated algæ, *S. obliquus* and *C. vulgaris*, differed clearly in morphology and in the amount and distribution of nucleic acids, proteins, lipids, and carbohydrates as compared with untreated algæ. They found more acidophilic proteins and basophilic nucleic acids present in the deuterated cells. Crespi *et al.* (1960) were also able to grow the unicellular algæ, *S. obliquus*, and the blue-green algæ *Plectonema cathricoides*, in 99·6% D_2O. A number of algæ, such as *Phormidium* sp., *Phormidium luridum*, *Nostac commune*, *Fremylla diplosiphon*, *Anacystis nidulans*, *Prophyridium cruentum* and the diatoms, *Phœcodactylum tricornutum* and *Navicula pelliculosa*, were cultured by them at D_2O levels from 75 to 99·6%.

Pratt and Curry (1937) investigated the effects of high concentrations of D_2O on the root and coleoptile growth of wheat. Wheat seedlings were arranged with their roots immersed in H_2O and 99–100% D_2O. The growth of primary and secondary roots and of coleoptiles was measured at definite intervals. It was observed that the growth of roots decreased to one-fortieth of the normal value when wheat seedlings with primary roots, approximately 3·9 mm. or 35 mm. long, were placed in contact with 99–100% D_2O. The secondary roots showed reduction in growth with D_2O. The growth of coleoptiles of seedlings with roots 3·0 mm. long decreased to about from one-half to one-third of the normal, but when seedlings with roots 35 mm. long were placed in 100% D_2O, coleoptile growth was not affected for more than 23 hours. Although the rate of germination of wheat seeds was strikingly reduced in 100% D_2O, the percentage of germination was the same in H_2O and 100% D_2O. Germination and growth were also reduced when 50% D_2O was used.

STIMULATING EFFECT OF DILUTE D_2O

Dilute deuterium stimulated growth in certain instances. Richards (1933) reported that the dry weight of yeast, *Saccharomyces cerevisiœ*, was 26% greater in deuterium treated with William's culture medium than in a culture with distilled water. Richards (1934) also claimed that yeast in media containing 0·05% D_2O showed an increase in cell volume of

11% over those grown in normal water. A greater increment in cell volume was seen when D_2O concentration was 0·025%.

Barnes (1933) found that filaments of *Spirogyra* lived longer in very dilute D_2O of 0·06% than in ordinary water at the same tempeature, pH and salt content. Barnes and Larson (1934) found that *Spirogyra* filaments lived about 0·3 days in 0·06% D_2O, while their longevity was 3·3 days in ordinary distilled water. Barnes (1934) showed that the population of *Euglena* increased in 0·06% D_2O faster than in normal water. Barnes and Gaw (1935) claimed that *Spirogyra nitida*, when grown in 0·47% D_2O, showed more longevity in the presence of light than in darkness. Ewart (1935) found that the growth rate was increased by 50% with *Chlamydomonas* in 0·1% D_2O. He observed that in the alga, *Phorindium autumnate*, growth was increased threefold after treatment in 0·01% D_2O for four months. He also noticed an acceleration in the rate of growth in the aquatic plant, *Lemma minor*, when subjected to 0·1% D_2O solutions.

Barnes and Larson (1934) observed that the planarian, *Phagocata gracilis*, kept in 0·06 mole per cent. D_2O, showed much less shrinkage in body size than the controls in ordinary water.

INDIFFERENT OR RETARDING EFFECT OF DILUTE D_2O

In some cases, dilute deuterium was indifferent in effect or retarded growth. Shoup and Meyer (1935) demonstrated that gas formation (CO_2) was decreased by 2·6% after 45 hours with 0·5% D_2O in Brewer's yeast. Ewart (1935) mentioned that the growth of yeast, *Saccharomyces cervisiece*, was similar when grown in water and 0·1% D_2O. He also noticed no difference in growth in the mold, *Penicillium citrinum*, in 0·1% D_2O. Curry (1935) detected no effect at concentrations between 0·05 and 0·46% D_2O on the growth of the mold, *Aspergillus niger*. Weiser (1937) reported that 0·13, 0·7 and 5% D_2O had no effect on the growth of the bacteria *Lactobacillus acidophilus* and *Lactobacilus bulgaricus*. Chance and Allen (1946) observed gross morphological changes in the bacterium, *Eberthella typhosa*, when grown in 8% D_2O, but the normal morphology was restored when the organisms were transferred to tap-water. Fox et al. (1936) found that the alga, *Nitzschia bilobata*, showed a slight retardation of growth in 1% D_2O. However, there was no effect in the case of *N. closterium*.

Delamater (1936) reported that 0·44% D_2O did not have any effect for 96 days on the protozoan, *Uroleptus mobilis*. Misra (1963) found that the eggs of the brook trout, *Salvelinus fontinalis*, were hatched in dilute deuterium concentrations of 1, 3 and 9% without any observable abnormality. The eggs grew exponentially and showed a significant reduction in growth rate as a function of deuterium concentration. The larvæ also grew exponentially and showed a significant but less regular reduction in growth in 1, 3 and 9% D_2O. The ultimate weight of larvæ developed from eggs incubated in the above concentrations of D_2O eventually became the same when they were placed in hatchery water. Mortality during embryonic development increased with increasing concentration of deuterium. Morphogenesis of the embryonic tissues was not altered in any way by dilute deuterium in the above concentrations.

REASONS FOR THE BIOLOGICAL EFFECTS OF DEUTERIUM

The reduced growth rate in D_2O may have been due to the physical and chemical properties of D_2O. Kritchivsky (1960) mentioned that heavy water differs from ordinary water in these properties. It has higher density and viscosity, higher melting and boiling points and is a poorer solvent for salts and gases. The carbon-hydrogen bond may be broken seven times faster than the carbon-deuterium bond, the N–H bond 8·5 times faster than N–D, and the O–H bond 10·6 times faster than the O–D bond. When deuterium replaces the hydrogen in macromolecules of a biological system, differences in the chemical activities of these macromolecules are expected. Morowitz and Brown (1953) reported that when deuterium replaces the hydrogen in the macromolecules in a biological system, it generally involves free energy changes. The latter in turn affect enzyme kinetics and the reaction rates of metabolic pathways. Gross and Spindel (1960 b) listed the following hypotheses for deuterium interferences with cell division in the eggs of the sea-urchin, *Arbacia punctulata*, in 50% D_2O.

1. The replacement of hydrogen by deuterium may lead not only to a generalized depression of metabolism, but also to a quantitative alternation of metabolic pathways.

2. If growth depends upon several critical intermediates produced by the required

nutrients, then the replacement of hydrogen by deuterium in one of the required nutrients will decrease the rate of production of the critical intermediates and will lead to slow growth. This second hypothesis is derived from the first.

3. In normal mitosis, DNA must be doubled and prior to each mitosis, the cells must synthesize the proteins and nucleoproteins of the mitotic machinery. Therefore, the constituent purines, pyrimidines and amino-acids should be first accumulated and then joined chemically to synthesize proteins and nucleoproteins. The third proposal is that deuteration blocks one or more steps leading to the synthesis of these precursors, or, alternatively, it inhibits the polymerization reactions.

4. The fourth hypothesis indicates that the substitution of deuterium for hydrogen may produce mutation in polymer molecules and lead to changes in the structure of DNA. Changes in DNA in turn affect chromosomal condensation, spiralization and splitting, and lead to mitotic disorders and finally to the death of the cell. According to this hypothesis D_2O acts as a mutagen.

5. The fifth hypothesis states that deuterium may affect the ground cytoplasm of mitosis responsible for the formation of spindle, asters and cleavage furrows. The ground substance of the cytoplasm is made of macromolecules structured by H-bonds and connected with each other by salt bridges. Deuterium acts upon this ground cytoplasm so that local structural changes occurring during mitosis are blocked. The blocking is reversible when the D_2O is washed out and replaced by normal water. Gross and Spindel (1960 b) supported this proposal for inhibition of mitosis in the eggs of sea-urchin, *Arbacia punctulata*, due to the reversibility of D_2O, continuation of some stages of replication during mitotic arrest and the stabilization of the mitotic apparatus in D_2O.

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ELIMINATION OF ANHYSTERETIC EFFECTS DURING ALTERNATING FIELD DEMAGNETISATION IN PALAEOMAGNETIC INVESTIGATIONS

V. PRASAD, P. C. PAL AND V. L. S. BHIMASANKARAM

Department of Geology, Osmania University, Hyderabad

IT is a common practise in plæomagnetic investigations to test a rock sample for its magnetic stability and to eliminate or sufficiently reduce the secondary magnetic components, if any. For this purpose two laboratory techniques are available, *viz.*, alternating field demagnetisation and thermal demagnetisation.

The principle of these demagnetisation techniques is based on the experimentally verified result that the primary magnetisation in a rock is more stable against demagnetisation than the secondary magnetisation. In the alternating field demagnetisation technique when a rock sample is subjected to an alternating magnetic field of a certain peak value the magnetic domains having coercive forces equal to or less than that of the applied field are alternately magnetised and demagnetised and when the applied alternating field is reduced to zero gradually these magnetic domains are carried through progressively smaller and smaller hysteresis cycles and are finally demagnetised. Since the secondary magnetisations, as mentioned earlier, are less stable than the primary magnetisation, the secondary components of the natural remanent magnetisation in a rock sample can be effectively removed by demagnetising the sample.

As a rule this demagnetising process should be carried out in a space free of any direct magnetic field, say that of the earth, since the superposition of any steady magnetic field over the alternating magnetic field results in the development of 'anhysteretic magnetisation'.[1,2] In general the compensation of the earth's magnetic field in the a.f. demagnetisation equipment is done by employing three pairs of Helmholtz coils set in a mutually perpendicular arrangement. These coils carry suitable direct currents and produce magnetic field which exactly balances the earth's magnetic field at the centre of the coil system. Such a coil system is also employed in highly sensitive astatic magnetometers used to measure the natural remanent magnetisation in the weakly magnetised rocks. This steady magnetic field, i.e., the earth's magnetic field, should be very critically balanced in the case of the a.f. demagnetisation for even small fields of the order of 50×10^{-5} Oersted may produce anhysteretic components which mask the direction as also the moment of the magnetic vector in the sample. This effect can be more serious when weakly magnetised samples are demagnetised, particularly at higher fields.

To measure the magnetic field and to determine the currents to be sent through the Helmholtz coils to compensate the earth's magnetic field, an earth inductor connected to a ballistic galvanometer is generally employed. The accuracy that can be attained following this technique is, however, not sufficient. In the absence of more sensitive instruments like flux gate magnetometer probes we have adopted the following procedure based on the phenomenon of the acquisition of anhysteretic magnetisation, to find the currents required to compensate the field thus facilitating the estimation of magnetic vector in the sample during successive stages of demagnetisation with greater accuracy. The alternating field demagnetiser constructed by us has been described elsewhere.[3]

First the currents 'i_x', 'i_y' and 'i_z' in the Helmholtz coils 'X', 'Y' and 'Z' required to compensate effect of the earth's magnetic field along the respective directions were found using the earth inductor and the ballistic galvanometer (Fig. 1).

A magnetically stable rock sample (Deccan Trap basalt) was then cut in the form of a cylinder of dimension $2 \cdot 5 \times 1 \cdot 25$ cm. (height and radius) and was placed in the a.f. demagnetizer with its axis (designated x-axis) parallel to the alternating magnetic field. The sample was demagnetised in this position at 380 Oersteds using the previously determined currents 'i_x', 'i_y' and 'i_z' in the respective Helmholtz coils. After demagnetisation the magnetic moments of the sample 'M_x', 'M_y' and 'M_z' along the three perpendicular directions were measured with a highly sensitive astatic magnetometer. Then the sample was placed in a reversed position, *i.e.*, antiparallel to the earlier position, and was again demagnetised at the same field using the same currents in the Helmholtz coils. The three components of

the magnetic moment of the sample were again measured. This procedure was repeated with different currents in the X-coil, say i_{x_1}, i_{x_2}, i_{x_3}, ...etc., on either side of 'i_x' without changing currents in the 'Y' and 'Z' Helmholtz coils.

FIG. 1. Compensation currents for the earth's field obtained for the three coil systems using earth inductor and ballistic galvanometer.

FIG. 2. Eliminations of anhysteretic magnetisation along X-component $M_{x_0} = 3.2 \times 10^{-3}$ emu. $i_{x_0} = 272$ mA, compare with $i_x = 260$ mA (Fig. 1).

Whenever the current in one of the Helmholtz coils, the 'X' coil in this case, is different

from the value of the current required to compensate the earth's field along that axis, x-axis here, an unbalanced magnetic field developed in that direction producing an anhysteretic magnetisation in the demagnetised sample. Calling the true x-component of the magnetic moment of the sample as 'M_{x_0}' the measured value can, therefore, be written as '$M_{x_0} \pm dM_{x_0}$' where 'dM_{x_0}' is the anhysteretic component in that direction. For the reverse position of the sample the measured moment will similarly be '$M_{x_0} \mp dM_{x_0}$' since the anhysteretic magnetisation will now be acquired in the reversed direction.

In Fig. 2 are plotted the measured x-components of the magnetic moment of the sample obtained after demagnetisation in the 'normal' and 'reversed' positions for various currents in the x-coils. The points fall roughly on a pair of straight lines which meet at a point with co-ordinates 'M_{x_0}' and 'i_{x_0}', the true value of the demagnetised x-component and the current required to compensate the field along the x-direction respectively. Further, the mid-points of the two measurements of the 'normal' and 'reverse' positions of the sample, also plotted in Fig. 2, fall reasonably on a straight line parallel to the current axis. This straight line cuts the ordinate at:

$$\tfrac{1}{2} \{ (M_{x_0} \pm dM_{x_0}) + (M_{x_0} \mp dM_{x_0}) \} = M_{x_0}$$

Thus, incidentally, one can take the average value of 'M_{x_0}' of this straight line as the true demagnetised value of the magnetic vector in the x-direction.

A similar procedure was adopted for the other two coils and the correct values of 'i_{y_0}' and 'i_{z_0}' were estimated. These results are, however, not being given here.

By the above procedure it is found that the compensation of the earth's magnetic field can be done more accurately than with the use of earth inductor alone. Subsequent studies have justified this conclusion, as evidenced by the fairly high quality of the demagnetisation results.

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LETTERS TO THE .EDITOR

THE n-π^* ELECTRONIC ABSORPTION SPECTRUM OF META-FLUORO BENZALDEHYDE IN VAPOUR PHASE

SPECTRA due to the n-π^* electronic transitions in carbonyl group have been studied by several workers. The longest wavelength band system of benzaldehyde has been extensively studied both in absorption[1] and emission.[2,3] This system is attributed to n-π^* transition. Like benzaldehyde, the halogenated[4,5] and other substituted[6] benzaldehydes give such absorption. The first report on the n-π^* absorption spectrum of meta-fluorobenzaldehyde is by Padhye and Viladkar who have reported only the position of the 0–0 band and a single principal excited state frequency. In this brief note we report the results of the n-π^* absorption spectrum of meta-fluorobenzaldehyde in vapour phase.

The absorption spectrum of the meta-fluoro-benzaldehyde vapour has been recorded on a Q–24 Zeiss medium quartz spectrograph at various temperatures between 30° C. and 200° C. The length of the absorption cell was 100 cm. A high pressure Xenon arc and a Tungsten filament lamp served as sources of continuous radiation.

The absorption spectrum lies in the region 4000–3218 Å and consists of 84 bands. The bands are sharp and are all red degraded. The 0–0 band has been measured at 26740 cm.$^{-1}$ The most intense band at a separation of 1344 cm.$^{-1}$ on the shorter wavelength side of the 0–0 band is assigned as the $C = O$ stretching frequency in the excited state. This along with its three overtones combines with other excited state frequencies. At high temperatures the $C = O$ ground state stretching frequency 1742 cm.$^{-1}$ is also observed. The other excited and ground state frequencies are collected in Table I.

TABLE I

Compound	Excited state frequency cm.$^{-1}$	Ground state frequency cm.$^{-1}$
Meta-fluoro-benzaldehyde	125, 165, 268, 325, 380, 457, 538, 597, 750, 961, 1043, 1213, 1344	195, 380, 420, 450, 530, 1385, 1620, 1742

Dept. of Spectroscopy,   M. P. SRIVASTAVA,
Banaras Hindu Univ.,   I. S. SINGH.
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ELECTRON AFFINITY OF ASTATINE

ACCORDING to Mulliken[1] electron affinity of an atom is related to its electronegativity (X) and ionization potential (I). These quantities (*i.e.*, X and I) in turn have been related by various investigators[2,3] with the vibrational constant of the corresponding homonuclear diatomic molecule. Therefore a relation between electron affinity (E_A) of an atom and vibrational constant (ω_{AA}) of the corresponding homonuclear diatomic molecule is also expected. It is shown in Table I that the atoms in VII *b* group of the periodic table obey the following relation :

$$E_A = 1.109 \times 10^{-3} \, \omega_{AA} \, \mu_{AA}^{0.6215}$$

where μ_{AA} is the reduced mass of the molecule in a.m.u.

TABLE I
Comparison of observed and calculated electron affinities (in Volts)

Atom	ω_{AA}^*	$E_{Obs.}$†	$E_{Calc.}$
F	919·0[4]	4·13	4·1295
Cl	564·9	3·72	3·7076
Br	323·2	3·49	3·5440
I	214·6	3·14	3·1376
At	139·0[3]	..	2·7872

* Taken from G. Herzberg. *Spectra of Diatomic Molecules* (D. Van Nostrand Company, Inc., 1950); if not indicated otherwise.

† Taken from page 219 of G. Herzberg, *Atomic Spectra and Atomic Structure*, Dover Publications (New York, 1944).

Table I clearly shows that there is fairly good agreement between observed and calculated values. The electron affinity of Astatine, which has not been reported so far, is predicted here.

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Meerut College, Meerut,
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OXIDATION OF DICYCLOHEXYL CARBINOL BY Cr (VI) OXIDE— A KINETIC CRITERION FOR THE CONFORMATION OF THE MOLECULE

As part of our investigations on the conformational aspects of the oxidation of secondary alcohols by chromium (VI) oxide, we have now studied the kinetics of the oxidation of dicyclohexyl carbinol in binary solvent mixtures of acetic acid and water under constant ionic strength and pH. One of us had studied earlier the kinetics of the oxidation of isopropyl alcohol, benzhydrol and cyclohexanol[1,2,3] and the compound under study was of interest because it is the alicyclic analogue of benzhydrol and the rate-enhancing influences of the phenyl groups in benzhydrol should be totally absent in dicyclohexyl carbinol and one might therefore expect the compound to react just as fast as isopropyl alcohol or cyclohexanol. Further, a Dreiding model of the molecule shows clearly that if the two cyclohexyl rings were to possess the chair conformations, the secondary –OH group will have a 1,3-diaxial interaction with the axial hydrogens on one ring or the other in one possible conformer, and in the other conformer, where the –OH could be equatorial-like, there is a very severe interaction between equatorial hydrogens on the 2 and 2' carbon atoms. The results of our experiments along with the rate data of earlier experiments are presented in Table I. The reaction is typically of the second order [first with respect to dicyclohexyl carbinol and next with respect to the total Cr (VI) concentrations] as in our earlier studies. The Arrhenius parameters of the reaction, obtained in the usual manner, are also given in Table II.

Although the expected retardation in rate in comparison with benzhydrol is observed, the compound under investigation is oxidised about 3-5 times faster than cyclohexanol or isopropyl

TABLE I

Solvent: 50% HOAC-H$_2$O   Ionic strength = 0·2

	$k_2 \times 10^4$ litre mol.$^{-1}$ sec.$^{-1}$		
	45°	50°	55°
Dicyclohexyl carbinol	2·947	4·119	5·431
Benzhydrol	8·913	11·750	..
Isopropyl alcohol	0·5665	0·780	..
Cyclohexanol	1·161	1·587	..

TABLE II

Solvent composition % HOAC-H$_2$O	ΔE K.cals.	$\log_{10}$ PZ	ΔS e.u.
50–50	12·880	5·285	−34·75
60–40	12·230	4·920	−36·34
70–30	11·040	4·483	−38·46

alcohol. This rate enhancement, we feel, is not due to any polar effect (because similar effects should have been present in either isopropyl alcohol or cyclohexanol) but is essentially steric in origin. The three-fold increase in rate in comparison with cyclohexanol is perhaps, an underestimate because the conformational equilibrium constant of cyclohexanol[4] is about 2·4 and the scale model of dicyclohexyl carbinol shows two definite 1:3–OH:H interactions in one conformer. The actual increase in rate over cyclohexanol is hence probably greater than the observed value. The steric situation in the compound under investigation is probably much more crowded than in cis-4- tert. butyl cyclohexanol or 3 α-cholestanol both of which are oxidised only three times faster than their corresponding equatorial isomers.[5,6] Alternatively the two cyclohexyl rings in dicyclohexyl carbinol may be present in the twist conformation with reduced –OH:H interactions and hence the benefit in rate may not be as considerable.

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Vivekananda College,   G. Srinivasan.
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THERMOGRAVIMETRIC ANALYSIS (TGA) OF POTASSIUM THIO-CARBONATE (K₂CS₃)

ANALYTICAL applications of potassium thiocarbonate (PTC) reagent, replacing the conventional use of gaseous hydrogen sulphide in qualitative[1-3] and quantitative[4,5] analysis of metal ions, has been extensively studied. Aqueous form of standard[6,7] PTC, being easy to prepare and store, is usually used after suitable dilution of the stock solution. Potassium thiocarbonate obtained in the solid form by methods as reported in literature[8] is uneconomical and less stable for which its use cannot be recommended as an analytical reagent. In the present communication, studies on thermogravimetric analysis[9] of a sample of solid PTC have been carried out with a view to establish purity and to ascertain mode of transformation of PTC in dry state, as also the stoichiometry of various products obtained with rise in temperature.

An aqueous solution of PTC (2 M) was prepared by a modified direct method.[6] Solid PTC was obtained by evaporating the aqueous solution under reduced pressure at 30°. Potassium thiocarbonate so obtained in the solid form was further dried in a vacuum desiccator for about 72 hours at room temperature.

The thermogravimetric data were collected using a Stanton's Thermorecording Balance model TR-I, installed at the Central Road Research Institute, New Delhi.

A weighed sample of dried PTC (1280 mg.) was transferred to a crucible freshly tarred to 1000° C. and subsequently stored in a desiccator. The sample was subjected to a heating rate of $4 \pm 0.2°$ per minute in an atmosphere of air. The data were collected for a range of temperature upto 1000° C. The period of maximum rise in temperature was about 4 hours, the sensitivity of the balance per small chart division being 1 mg. and chart range 100 mg. All data used in the preparation of the thermogravimetric curve were corrected for buoyancy (experimentally determined for the crucible used). The thermogram shown in Fig. 1 was obtained by plotting different points of the original graph on X- and Y-axes. All other instructions for operating the Stanton's Thermo-Balance given in the brochure supplied with the instrument were strictly followed.

Thermogravimetric Behaviour of K₂CS₃.— Potassium thiocarbonate apparently lost adherent

water upto 120° as shown by the thermogram (Fig. 1). The decrease in weight from 120° to 350° was due to the loss of carbon disulphide from K_2CS_3. The loss in weight initially was abrupt, subsequently gradual and during this interval K_2CS_3 was converted into K_2S. Side by side partial oxidation of potassium sulphide gave a visible minimum at 350° due to the mixed character of the product at this stage. From 350° to 550° there was an increase in weight apparently due to the progressive oxidation of K_2S to potassium persulphate ($K_2S_2O_8$).

FIG. 1. Thermal decomposition of potassium thiocarbonate (PTC).

The persulphate further decomposed into potassium sulphate and the decomposition was complete by 760°. The constant weight of the residual product between 760° and 1000° corresponded to the composition, K_2SO_4.

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Department of Chemistry,   K. N. JOHRI.
University of Delhi,   N. K. KAUSHIK.
Delhi-7, *May* 11, 1967.   KIRPAL SINGH.

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SIDE PRODUCTS IN THE PREPARATION OF ETHYL 7-CHLORO-4-HYDROXYQUINOLINE-3-CARBOXYLATE—AN INTERMEDIATE FOR CHLOROQUINE[1]

DURING large-scale preparation[2] of 7-chloro-4-hydroxyquinoline-3-carboxylic acid (I), an intermediate for chloroquine and amodiaquine, from diethyl ethoxymethylenemalonate (EMME) and *m*-chloroaniline three side products have been isolated and identified. These are 7-chloro-1-ethyl-1:4-dihydro-4-oxoquinoline-3-carboxylic acid (II), m.p. and mixed m.p. 279° (lit.[3] 274°) ($\lambda_{max.}^{EtOH}$ 254, 262, 319, 330 mμ. $\nu_{max.}^{Nujol}$ 1708, 1689, 1608, 1553, 1546, 1502 cm.$^{-1}$), 7-chloro-4-ethoxyquinoline (III), m.p. and mixed m.p. 105° (lit.[4] 103°) ($\lambda_{max.}^{EtOH}$ 227, 280, 288 mμ) and 7-chloro-1-ethyl-4-(1 H)-quinolone (IV), m.p. 187° ($\lambda_{max.}^{EtOH}$ 217, 248, 255, 326, 339 mμ. $\nu_{max.}^{Nujol}$ 1634, 1629, 1592, 1582, 1543, 1497 cm.$^{-1}$).

The compound (IV) afforded a hydrochloride, m.p. 203° and a picrate, m.p. 208°. Bromination of (IV) in acetic acid yielded the corresponding 3-bromo-compound, m.p. 196°. The structure of (IV) was elucidated by spectral evidences and synthesis. Ethylation of 7-chloro-4-hydroxyquinoline (V) with ethyl iodide and caustic soda afforded (IV), m.p. and mixed m.p. 187° together with some 7-chloro-4-ethoxyquinoline (III). Thermal rearrangement of (III) at 250° or decarboxylation of (II) also resulted in the formation of (IV).

(I)   R=COOH   (II)   R=COOH
(V)   R=H   (IV)   R=H
(VI)   R=COOC$_2$H$_5$ (VII)   R=COOC$_2$H$_5$

(III)

Purity of EMME and the pyrolytic behaviour of ethyl 7-chloro-4-hydroxyquinoline-3-carboxylate (VI) play a significant role in the formation of these side products. It has been demonstrated that heating of (VI) in refluxing diphenyl ether led to the evolution of carbon dioxide with concomitant formation of (III), (IV), (V) and ethyl 7-chloro-1-ethyl-1:4-dihydro-4-oxoquinoline-3-carboxylate (VII), m.p. and mixed m.p. 158° (lit.[3] 154–158°).

In explaining the formation of all these products from (VI) the following mechanism is suggested—the initial step in the reaction may be visualised as the formation of ethyl carbonium ion and the corresponding anion from (VI). The carbonium ion may attack the N atom in (VI) to form an intermediate cation from which the proton may be picked up by the anion leading to the formation of (VII) and (I), the latter decarboxylating to (V). The ethyl carbonium ion may also attack the O atom at the 4-position in the anion leading to the formation of 7-chloro-4-ethoxyquinoline-3-carboxylic acid which would decarboxylate to (III). Thermal rearrangement of (III) would afford (IV).

Pyrolysis of (VI) in presence of benzoic acid has yielded 7-chloro-4-hydroxyquinoline (V), ethyl benzoate and carbon dioxide pointing out to the intermolecular nature of the reaction.

Recently it has been observed that pyrolysis of ethyl 4-hydroxyquinoline-3-carboxylate led to the formation of 4-ethoxyquinoline, 1-ethyl-4-(1 H)-quinolone and carbon dioxide.[5]

The pyrolytic behaviour of (VI) partially explained the appearance of side products in the preparation of (I) as discussed previously. But very often their quantity varied widely under standardized conditions. It appears that this may be due to the presence of hitherto unidentified impurity in EMME.

Bengal Immunity   AMITABHA RAYCHAUDHURI.
  Research Institute,   U. P. BASU.
39, Acharyya
  Jagadish Bose Road,
Calcutta-16 (India),
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DEMONSTRATION OF THE NUCLEUS AND THE NUCLEAL DNA AND RNA OF THE BASAL MELANOCYTE OF THE WHITE GUINEA-PIG

SHUKLA[1] described a method to visualise the isolated and unstained basal albino melanocyte[2] of the white guinea-pig under the phase (Fig. 1). As the nuclei of these cells, hitherto, had not been visualised under the light microscope, a method to differentiate the same and discern their nucleic acid content is described.

Pure epidermis sheet, prepared from the dorsal surface of the pinnæ of the white guinea-pig after Medawar,[3] was digested in a solution of 3, 4-dihydroxyphenylalanine in normal saline according to the method described by Shukla et al.[4] The digest was mounted on albuminised slides and dried at 58° C. in an oven. After an hour of drying the cells were affixed to the slides, and fixed in 5% formalin for 30 min. and washed in running water for four hours. The slides were stained by (I) Harris's hæmatoxylin and eosin and Mayer's hæm alum[5] and (II) 4 : 1 mixture of 5 mg./ml. solution of methyl-green-pyronin–Y in distilled water at a pH of 4·8 for 30 min. after Kurnick[6] and subjected to Feulgen reaction for DNA, hydrolysing the preparation for one min. in N HCl at the room temperature and then 4 min. in N HCl at 60° C. after Cowdry.[7] As a control for the stain for RNA, another group of slides, after washing in glass-distilled water, was incubated in 1 mg./ml. solution of ribonuclease in glass-distilled water for an hour and then subjected to methyl-green-pyronin–Y stain as before.

The nucleus of the basal albino melanocyte, except for being small in size, was found to be isomorphous with the nucleus of its counterpart in the skin of the black guinea-pig.[8] It was observed to be a constant, singly occurring, basophilic structure in the centre of each cell, occupying nearly 2/3rd of its cytoplasm (Fig. 2). The nucleus was shaped like an elongated egg and showed a smooth and regular border. A little posterior to the narrow end there were two smooth indentations on the boundary wall of the nucleus (shown by the two arrows in Fig. 2). The anterior notch lodged the Golgi complex (under preparation). The nuclei approximately measured $10 \times 6\,\mu$ at the longest diameters.

The Feulgen reaction revealed that the nuclear DNA was condensed in the form of granules of different sizes, some being very coarse, on the network of chromatin (Fig. 3, g). Methyl-green-pyronin-Y stain developed deep blue colour over the same area. This, while confirming the results of Feulgen reaction, qualified further that the nuclear DNA was in highly polymerised state[9] (Fig. 4).

The nucleolar RNA was found to be Feulgen negative and pyronin-Y positive. It was visualised in the form of two bright red and tiny spherules, each of the diameter of about $1\,\mu$ (Fig. 4, nl). Both the spherules were

FIGS. 1-4. Fig. 1. The isolated and unstained basal melanocyte of the white guinea-pig with seven dendritic processes, visualised under the phase. The internal structure of the cell is not visible, × 950. Fig. 2. Shows two melanocytes marked A and B stained with Mayer's hæm alum, respectively having 5 and 8 dichotomously branched and bulb-tipped (bt), dendritic processes (dp). Each melanocyte showed an egg-shaped, double-notched (shown by two arrows) basophilic nucleus (n) in the centre, × 950. Fig. 3. Showing the granulated appearance (g) of the deep red stained particles of DNA, dispersed on threads of chromatin, × 950. Fig. 4. Showing the nucleus of the basal melanocyte of the white guinea-pig after M.G.P.–Y stain, photographed under a certain stage of the phase to bring out the two bright red stained spheroidal dots of RNA (nl) against the deep blue background of the nuclear DNA, × 650.

surrounded by a small clear zone, the outer boundary of which was seen to merge into the surrounding mass of DNA. After examining a number of slides it was found that the anterior

nucleolus was always located close to the anterior notch, which lodged the Golgi complex.

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HISTAMINE AND 5-HYDROXY TRYPTAMINE IN PULMONARY OEDEMA

PULMONARY œdema induced in experimental animals with intravenous injections of adrenaline has been used for study as a laboratory model of the clinical disease. It has been suggested that the process may be related to a capillary damaging action of adrenaline[1,2] and this may be consequent upon release of histamine[3] or 5-HT. This possibility was examined during the course of the present study.

Pulmonary œdema was induced by intravenous injection of adrenaline in the rabbit (2 mg. per animal) and in the mouse (2 mg./kg. body weight). The severity of the process was quantitatively gauged by noting relationship of lung weight with body weight, expressing it as a per cent. value (LBI[4]) and by noting one hour mortality.

Histamine is known to produce pulmonary œdema[5] and we have reported separately that 5-hydroxy tryptamine (5-HT) fails to produce the same in the rabbit. Injections of 5 HT in the mouse did not produce significant increase in the lung weight.

Injections of 5-HT given simultaneously with injections of adrenaline protected both rabbits ($p = 0 \cdot 02$) and mice ($p = 0 \cdot 05$) against death due to pulmonary œdema though alterations in lung body weight index were not significant.

In the next experiments, the effect of pretreatments with 2-bromolysergic acid diethylamide (BOL) which antagonises 5-HT, mepyramine which specifically antagonises histamine and dibenzyline which similarly antagonises adrenaline were studied.

Injections of BOL in dosages of 4 mg./kg. body weight did not significantly alter the increase in lung weight due to adrenaline but 1 hour mortality rate was reduced significantly in the rabbit ($p = 0 \cdot 05$). Mepyramine in doses of 10 mg./kg. body weight afforded significant protection against adrenaline induced pulmonary œdema in the mouse ($p = 0 \cdot 05$). Dibenzyline (2 mg./kg.) also prevented development of pulmonary œdema by injections of adrenaline in the rabbit ($p = 0 \cdot 05$).

In order to determine, if there is any alteration in the histamine or 5-HT content of the lung, pieces of tissue were examined before and after injection of adrenaline. The injection of adrenaline may produce œdema and as such gain in the weight of the tissue. This has to be corrected by making an approximate allowance for gain in weight by referring to the altered lung body weight index. Under such circumstances it was seen that there was 3-4 fold rise in histamine content of the lung and 2-3 fold rise in 5-HT contents after injections of adrenaline. The platelets in the rabbit are rich sources of histamine and 5-HT[6,7] and it therefore seemed possible that the raised value could possibly be due to trapping of platelets in damaged capillaries of the lung.

Another way of studying relative roles of histamine and 5-HT in any process is to study the effect of preferential depletion of either amine by using reserpine or polymixin.[8]

However such treatment failed to afford significant protection against adrenaline-induced pulmonary œdema either in the rabbit or in the mouse.

On overall assessment of the results, it would appear that the role of histamine or 5-HT in production of adrenaline-induced pulmonary œdema cannot be a dominant one. There may be accumulation of platelet leading on to a rise in histamine and 5-HT contents of the lungs. The protective effect of dibenzyline can be easily accounted for by its antagonistic action to adrenaline. 5-HT, as well as 5-HT antagonist drugs opposed actions of adrenaline. The mechanism of this action is obscure. As histamine accumulates in lung and may produce œdema on its own as well as assist adrenaline in production of œdema,[4] the protective effect of mepyramine is explained.

Dibenzyline used in these experiments were received from S.K.F. (England). BOL-148 was received from Sandoz (Basle) through kind

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FOSSIL WOOD OF *LANNEA* FROM THE TERTIARY OF ASSAM

A NEW fossil wood belonging to the genus *Lannea* of the family Anacardiaceæ is recorded here from a road cutting at milestone 9 on Dimapur-Diphu road in Mikir Hills, Assam. The fossil is represented by a small piece of decorticated secondary wood and shows the following characters :

Growth rings indistinct. *Vessels* small to moderately large, t.d. 75–230 μ, r.d. 120–340 μ, solitary as well as in radial multiples of 2–4 cells (Fig. 1), the solitary vessels round to oval in cross-section, sometimes elliptical, 7–11 per sq. mm. ; vessel-members 180–360 μ long, truncate or with tailed ends ; perforations could not be seen ; intervessel pit-pairs large, 10–12 μ in diameter, bordered, alternate, border oval and angular due to crowding with linear-lenticular apertures (Fig. 2) ; heavily occluded with tyloses. *Parenchyma* scanty paratracheal, occurring as few cells about the vessels (Fig. 1). *Xylem rays* 1–7 (mostly 3–4) seriate, rarely with gum canals (Fig. 3) ; rays 6–8 per mm. ; ray-tissue heterogeneous ; rays heterocellular consisting of procumbent cells in the middle portion and 1–2 rows of upright cells at one or both the ends. *Fibres* moderately thick-walled with big lumina, septate, polygonal in cross-section. *Intercellular canals* horizontal, normal, confined to the xylem rays, 25–35 μ in diameter (Fig. 3).

A detailed examination of the modern woods with radial gum canals (Anonymous, 1963, pp. 264–323 ; Desch, 1957, pp. 6–29 ; Pearson and Brown, 1932, pp. 309–347) indicate that the present fossil wood is closely allied to the

FIGS. 1–3. *Lanneoxylon grandiosum* gen. et. sp. nov. Fig. 1. Cross-section of the fossil wood showing the vessel distribution, $\times$ 43. Fig. 2. Magnified intervascular pittings, $\times$ 850. Fig. 3. Tangential section of the fossil wood showing gum-canal in the xylem rays, $\times$ 75.

modern genus *Lannea* A. Rich, especially to *L. coromandelica* (Houtt.) Merr. [Syn. *L. grandis* (Dennst.) Engler, *Odina wodier* Roxb., *L. wodier* (Roxb.) Adelb] (Raizada, 1958, p. 491). It also shows resemblance in gross features with the genera *Garuga* and *Boswellia* of the family Burseraceæ. However, there are some important anatomical details which distinguish the present fossil wood from these genera. The present fossil wood from the Mikir Hills is, therefore, described here as *Lanneoxylon grandiosum* gen. et sp nov.

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Lucknow (India),
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AN AMMOCOETE LARVA OF *ENTO-SPHENUS LAMOTTENII* (LESUEUR) WITH AN ACCESSORY TAIL

AMONG some formalin-preserved larvæ of the lampreys (Cyclostomata) obtained from Mr. M. L. H. Thomas of the Fisheries Research Board of Canada, London (Ontario), one large ammocœte larva of the species *Entosphenus lamottenii* (LeSueur) was found to possess an accessory tail (Fig. 1). This additional tail was a well-developed, stout structure of

FIG. 1. The primary and accessory tails of an ammo-cœte larva of *Entosphenus lamottenii* (LeSueur). The tail was kept flat under a glass sheet while photographing. The arrow indicates the dorsal margin of the accessory tail at the point of its emergence from the primary tail.

normal shape and had arisen on the left side of the primary tail about 2/3 the distance from the cloaca. On sectioning, the accessory tail was found to be anatomically complete with a well-formed caudal fin, fin-rays, myotomes, spinal cord, notochord and blood vessels. The spinal cord and the notochord of the accessory axis were continuous with the corresponding organs of the primary axis at the point of origin of the former. The accessory axis had grown latero-posteriorly within the substance of the primary tail for some distance before emerging to become a full-fledged accessory tail with its own fin, fin-rays, myotomes, etc.

Earlier, Barfurth (1900) had also described an ammocœte larva of *Petromyzon planeri* with three tails, each of which was anatomically complete in all details. Such cases are of interest not only because they constitute animal curiosities but also because an analysis of the morphology of such forms can frequently serve as a guide to experimental work to elucidate the causative mechanisms involved in such development. Thus, speculating on the possible manner of production of three tails in one larva Barfurth had suggested that these animals might possess powers of regeneration and that some peculiar kind of injury followed by regeneration would have caused the formation of three tails from one. It is now known for certain that the larvæ of the lampreys do possess good ability to regenerate tail and the whole process is well understood (Niazi, 1963).

Experimental production of accessory tails has never been attempted in ammocœtes but it has been successfully achieved in urodeles and in the anuran larvæ. Success or failure of such attempts largely depends on the proper knowledge or otherwise of the roles which the different component tissues of the tail play in its morphogenesis and differentiation. In urodeles, the spinal cord is the key-component and is indispensable for regeneration. Mere deflection of the spinal cord in the urodeles to an angle away from its antero-posterior path in the tail causes the development of an accessory tail (Holtzer, 1956). In the anuran tadpoles on the contrary, proper morphogenesis of the tail depends on the notochord, whose presence is indispensable for regeneration of a normal tail. To produce an accessory tail in these tadpoles it is necessary that two or more centres of notochordal regeneration are established. The presence or absence of the spinal cord is said to be immaterial for tail regeneration in the tadpoles of frogs and toads

(McCallion, 1948; Roguski, 1957). In this respect Barfurth's and our observations on the ammocœtes with multiple tails place the lamprey larvæ in a somewhat different category as compared to both urodeles and the anuran tadpoles. In the ammocœte larvæ both the spinal cord and the notochord are indispensable for proper regeneration of the tail (Niazi, 1964). On this basis, a method can be suggested to produce accessory tails in these animals with a reasonable chance of success. This can be achieved if the primary tail is injured sufficiently deeply on its dorsal, lateral or ventral sides. The injury should be deep enough to affect both the spinal cord and the notochord apart from damaging the peripheral tissues. The resultant blastema would then contain cells of notochordal, myotomal and connective tissue origin and a regenerating spinal cord. Becoming established on the injured site of the primary tail this blastema would give rise to an anatomically complete accessory tail. It is reasonable to assume that in the ammocœte reported here, a similar process must have occurred.

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CYTOCHEMISTRY AND ROLE OF THE MITOCHONDRIA DURING THE OOGENESIS OF THE PRAWN, *MACROBRACHIUM* (CRUSTACEA)

THE usual chemical constituents of the mitochondria in the oogenesis of various animal species are proteins, lipoproteins and phospholipids along with RNA which is present only in a few species (*see* Raven[1] and Nath[2] for references). Recently André[3] in his review has shown the presence of carbohydrates in the mitochondria of various cell types but not in the egg cells. However, the mitochondria in the oocyte of *Plexippus*[4] give PAS-positive reaction.

The mitochondria in the oocytes of *Macrobrachium siwalikensis* are in the form of granules aggregated mostly close to the nucleus in the young oocytes (Fig. 1 *a*). Later on they increase in number and size, and arrange themselves in the form of a circumnuclear ring (Fig. 1 *b*) which gradually expands towards the peripheral ooplasm and form the compound yolk (*cf.* Bhatia and Nath[5] in *Palæmon*) (Fig. 1 *c*). The mitochondria of the early oocytes appear as greyish granules in iron hæmatoxylin preparations and conspicuously red in acid fuchsin. In living oocytes they stain blue with Janus green B. The unmodified mitochondria are stainable with Janus green B and acid fuchsin even in advanced oocytes but the peripheral mitochondria fail to take stain with both the dyes as they are transformed into the compound yolk.

FIG. 1 *a–c*. Photomicrograph of the developing oocytes showing the distribution of the mitochondria with PAS technique. M = mitochondria, N = nucleus, Y = compound yolk.

The mitochondria take up a brilliant pinkish-violet colour in periodic acid-Schiff (PAS) test[6] in the early oocytes. The intensity of this colour is enhanced in vitellogenic oocytes (Fig. 1 *a–c*). This positive reaction of the mitochondria in PAS is completely negatived after acetylation but is again restored by KOH.

The PAS positive colouration is thus not due to lipids.[7]

The mitochondria give a bright blue colour in mercuric bromphenol blue, and red with pyronin G. They are negative to acid hæmatein and Nile blue sulphate. They are feebly sudanophil. The sudanophilia of the mitochondria is not affected at all by cold acetone and ethanol extractions but is lost completely in methanol chloroform mixture.

Therefore, it can be concluded that the mitochondria in *Macrobrachium* oocytes are rich in carbohydrates, proteins, RNA and also contain some unidentified lipids.

On cytochemical and morphological basis, it could appear that the mitochondria in the oocytes of *Macrobrachium* are directly transformed into the compound yolk as they contain the same chemical constituents of the compound yolk, *viz.*, carbohydrates and proteins along with some RNA which helps in protein synthesis.

I wish to thank Prof. Vishwa Nath, Emeritus Professor (Panjab University), for direction and supervision of this work.

Department of Zoology,   P. D. Gupta.
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PROLONGATION OF SPAWNING SEASON IN THE CARP *CIRRHINA REBA* (HAM.) BY ARTIFICIAL LIGHT TREATMENT

THE commercially important species of Indian carps breed normally in rivers and bundh-type of tanks during monsoon months and the particular seasonal climatic conditions are found to exert considerable influence in the spawning.[1,2] If the rains are delayed or are insufficient to bring about the required environmental changes, the breeding of carps is likely to be affected.[3]

In small confined water areas these fish develop functional maturity at the time of the natural spawning season, but as they do not breed normally under captivity, the mature gonads undergo a process of resorption and the ova generally degenerate within the ovary.[2,3] The administration of pituitary hormone to induce carps to breed has so far been found to be effective only during the natural spawning season, when the breeders are in their prime stage of maturity.[4] It is also known that when resorption of eggs starts in the ovary, the fish respond poorly to pituitary injection.[4]

Light and temperature are considered to be of critical importance in bringing about changes in the gonads of fish.[5-8] Since this aspect of the problem has not yet been studied in the case of Indian carps, investigations have been initiated at the Central Inland Fisheries Research Institute, Barrackpore, on the influence of light and temperature in the reproductive cycle of Indian carps.

For the preliminary experiments, *Cirrhina reba*, a minor carp, collected from a local stocking pond during June 1966 were used. The fish were of size varying from 60 to 95 mm. in total length. At the time of collection, few fish above 85 mm. in length were with maturing gonads, while the rest were immature. All the fish were reared in cement cisterns measuring $180 \times 100 \times 70$ cm., containing tap-water. The water was kept well aerated by bubbling air from an air compressor and this was found sufficient to maintain the dissolved oxygen level at 4 to 5 ppm. After the fish got acclimatised to the conditions in the cisterns, incident light was controlled by using two 40 watts fluorescent tubes fixed 1.5 m. above the water-level and covering each cistern along with the lamps with black cloth. Photoperiodic regimes of 8 hours, 14 hours and 18 hours of artificial light per day were adopted for these experiments with effect from August 1, 1966. A control cistern was maintained under natural daylight. Uniform conditions were maintained in respect of all other factors.

At monthly intervals, the lengths of fish were measured and specimens that appeared to be mature were tested for functional maturity by stripping. The results obtained by stripping are presented in Table I. All the fish were returned to their respective cisterns after partial stripping. Efforts were also made to fertilize the ova with the milt collected from fish of the

TABLE I

Details of stripping Cirrhina reba *kept under different light conditions*

Date of observation :	26-9-1966		13-10-1966		25-11-1966	
Nature of light treatment	Size in mm. and sex	Result of stripping	Size in mm. and sex	Result of stripping	Size in mm. and sex	Result of stripping
18 hours of artificial light per day	105 F	Yielded transluscent ova in strings	114 F	Yielded transluscent ova in strings	115 F	Yielded transluscent ova in strings
	109 F	do.	100 M	Oozed milt	106 F	do.
	114 M	Oozed milt	98 M	do.	110 M	Oozed milt several times
	95 M	do.				
	107 M	do.				
14 hours of artificial light per day	107 M	Oozed milt	105 F	Yielded transluscent ova	115 M	Oozed traces of milt and subsequent pressing of no effect
	106 M	do.	101 F	do.		
	98 F	Yielded transluscent ova	110 F	do.	128 F	Did not release eggs*
	100 F	do.	110 M	Oozed milt	99 F	do.
	107 F	do,	110 M	do.	100 F	Few eggs came out in a bunch†
8 hours of artificial light per day	98		104		105	
	100		102		105	
	103	Did not yield sexual products	99	Did not yield sexual products	107	Did not yield sexual products
	105		106		109	
	101		103		98	
Control	103		110		116	
	106		105		113	
	108	As above	103	As above	110	As above
	98		112		108	
	98		99		98	
					102	

F. Female; M. Male.   * On dissection the ovary was found to be shrivelled up with shapeless ova undergoing degeneration;   † The ovary appeared in a state of resorption with network of blood capillaries over the surface. In the last two sets the sex of the fish could not be determined as they did not yield any sex cells.

same cistern. The nature of oozing of ova and milt by the fish, the translucency of the extruded ova and the swelling of ova on mixing with milt have been considered in attributing spawning condition to the fish. This, of course, is somewhat arbitrary and definite criteria are to be specified after further investigations.

From these observations it is evident that, fish kept under 14 and 18 hours of artificial light per day were in spawning phase when similar sized fish from the control set and 8 hours light group did not respond to stripping. Fish under 18 hours of light remained in the same condition till the last week of November. This is quite unnatural since, the spawning season for carps in general, lasts from mid-May to end of August[4] and for *C. reba* in particular from June to October.[9-11] It is of interest to mention here that a set of the same species with advanced maturity and reared separately under normal daylight apart from the experimental groups, passed the spawning phase by first week of October as evidenced by the degenerating ovaries recovered from them.

In the light of the above observations, it appears possible that, effect of light in the retention of viable germ cells beyond the natural spawning season is very much significant. In nature, the shortening of day length towards the approach of winter may be one of the main factors that causes the onset of resorption in the gonads of carps.

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ON THE OCCURRENCE OF *PHERETIMA PEGUANA* (ROSA) (OLIGOCHAETA—MEGASCOLECIDAE) FROM CALCUTTA

In a collection from Calcutta there is a well-preserved clitellate specimen of *Pheretima peguana* (Rosa), collected by S. B. Roy and Aneg Singh on 3-9-1963 from St. Paul's Cathedral. *P. peguana* is common in Bruma, but its original home is over in the south-eastern portion of the continent beyond Burma. Gates[1] states that there may be a possible occurrence of this species from Chittagong (E. Pakistan), but in a recent personal communication he informs that he could not see a specimen of the species collected from Chittagong nor from anywhere else that could now be thought to be either in India or Pakistan. He recognized 13 species from India, to which he added one more, *P. birmanica* (Rosa) (Gates).[2] Each of these species is regarded as a recent importation or immigrant. The record of *P. peguana* is of interest and increases the total number of species of *Pheretima* from India to 15.

Pheretima peguana (Rosa)

Perichæta peguana, Rosa, *Ann. Mus. Geneva*, 10 (2), 1890, p. 113, pl. i.

Pheretima peguana, Stephenson, *Fauna Brit. India*, Oligochæta, 1923, p. 308.

Length 108 mm., diameter 5 mm. Prostomium proepilobous. Dorsal pores from 12/13. Clitel-

lum xiv-xvi. Spermathecal pores 3 pairs in 6/7-8/9, in line with *i*. Male pores with anterior and posterior lips, in line with *h*. Genital papillæ two pairs, in 17/18-18/19. Gizzard in viii. Prostates lobed occupying 4 segments; duct looped. Spermathecal ampulla sac-like; diverticulum long, much coiled and enclosed in a sac.

The occurrence of *P. peguana* in Calcutta can probably be due to transportation through the plant material with which earthworms are often transported. Further efforts are being made to collect more specimens which would indicate a tentative or permanent colonization in accordance with numbers found.

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DIRECT EVIDENCE FOR SCHIZOGENOUS SPLITTING IN PALM-LEAF LAMINA

The occurrence of schizogenous splitting of cells during the early meristematic phase of the lamina of the palm-leaf was discovered as early as 1845 by von Mohl. He employed the concept of splitting to explain the origin of the plicate lamina in palms. However, subsequent workers ignored the important contribution of von Mohl and instead put forth their own theories resulting in a highly controversial literature. Yampolsky's (1922) review did much to clarify the issues and confirm von Mohl's findings. Eames (1953) added support to the findings of von Mohl and Yampolsky in so far as the role of splitting is concerned. Despite this, no attempt was made to demonstrate and study the splitting in thin sections of the laminal meristem. The author was able to observe and photograph the lines of splitting in leaf primordia of *Phœnix*.

Schizogenous splitting occurs very early in the development of lamina when its thickness measures 5-8 layers of cells. The meristematic cells which undergo schizogenous separation are more or less polygonal. Hence the lines of

468

splitting are initially zig-zag (Fig. 1). However, as the separated cell walls grow and expand the line of splitting straightens out. Once separation has occurred the split halves tend to flare apart and the interspace between them increases (Fig. 1).

I am grateful to Prof. T. S. Sadasivan for facilities and encouragement.

University Botany Lab.,   D. PADMANABHAN.
Madras-5 (India),
May 16, 1967.

FIG. 1. *Thænia sylvestris*. Highly magnified view of a section of the laminal meristem showing zig-zag course of schizogenous splitting due to the polygonal shape of meristematic cells. Note the straightening of the exposed walls due to growth and elongation, × 800.

The three dimensional aspects of splitting were also studied. It was observed that the cells which undergo splitting are more or less isodiametric at the time of schizogenous separation. Hence the confrontation of a facet of cell wall of the lower or upper layers making splitting difficult does not occur. In fact, in both length and depth the lines of splitting are initially zig-zag. In other words, the split surfaces are initially uneven. As the tissue keeps on growing during the process of splitting, the marks of schizogenous separation quickly become obliterated. However, careful examination of the ends of split lines gave clear evidence of schizogenous separation.

Another aspect relates to the question of organization of protoderm after splitting. This is accomplished by the exposed cells which soon become increasingly rectangular (Fig. 1) and assume the characteristics of an epidermis.

The role of schizogenous splitting in bringing about the plicate condition has already been published (Padmanabhan, 1962).

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CATENARIA VERMICOLA ON NEMATODES IN INDIA

WHILE conducting a survey for plant parasitic nematodes in sugarcane soils in certain parts of Madras State,[2] it was observed that a few nematodes were parasitised by a sporangium-forming fungus. Subsequently, infected nematodes were observed in soil samples obtained from sugarcane fields in Mysore, Andhra Pradesh, Madhya Pradesh, Orissa, Bengal, Bihar, Punjab and Uttar Pradesh.

Species of *Hoplolaimus*, *Helicotylenchus*, *Pratylenchus*, *Tylenchorhynchus*, *Hemicriconemoides*, *Hemicycliophora*, *Xiphinema*, *Paralongidorus*, *Longidorus* and *Dorylaimus* have so far been found parasitised by this fungus in nature.

thallus of the fungus is within the nematode. It appears to enter into the nematodes through oral, vulval or anal openings (Fig. 1). It develops fine strands of septate hyaline hyphæ,

FIGS. 1-4. *Catenaria vermicola* parasitising nematodes. Fig. 1. Mass of zoospores attached to lip region of *Hemicycliophora* sp. Fig. 2. Mycelium with septa developing within nematode body. Fig. 3. Intercalary sporangia within *Hoplolaimus indicus*. Fig. 4. An empty sporangial sac (Figs. 1 & 2, ×380; Figs. 3 & 4, × 730).

running length-wise (Fig. 2). After every 1 or 2 cells, one cell swells up. The contents within these become granular and a second cell-wall is developed, to form intercalary sporangia (Fig. 3). Sometimes the contents of swollen cells round up and develop a thicker wall forming a resting spore.

Sporangia develop a protuberance which soon forms a discharge-tube. The latter grows through the body wall of the host. The cell-wall at its tip dissolves to form a passage. Zoospores emerge out of the sporangium in mass, through this passage. Empty sporangia retain their shape and fill up the carcases of the nematodes (Fig. 4). Rhizoids, like those reported for *Catenaria anguillulæ* Sorokin,[3] were not observed.

Zoospores are oblong in shape, $2 \cdot 5 - 3 \cdot 0\,\mu$ to $3 \cdot 4 - 4 \cdot 5\,\mu$ in size and have 4 to 6 granules. There are posteriorly uniflagellate, move briskly in water, reach other nematodes and cause fresh infection. A number of zoospores may be often seen attached at the oral openings of the nematodes (Fig. 1). The measurements and the description of this fungus broadly agrees with that given for *Catenaria vermicola* Birchfield.[1]

The disease spreads fast. In an experiment, four adults of *Hoplolaimus indicus* Sher, infected with *C. vermicola*, were added to a mixed population of about 250 nematodes suspended in water. Within a fortnight, majority of the population was parasitised by the fungus.

Soon after the zoospores establish contact with a nematode it becomes very sluggish, indicating toxæmia. The fungus appears to consume the internal organs which disappear gradually subsequent to development of mycelium within a nematode. A part of the cephalic framework, the anterior portion of stylet and the spicules do not appear to be affected. The body wall of a dead nematode retains its shape for some time.

Indian Institute of Sugarcane   KISHAN SINGH.
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ON THE OCCURRENCE OF CHROMOSOMAL VARIABILITY IN THE SOMATIC CELLS OF *ELEPHANTOPUS SCABER* LINN.

THE normal diploid complement of chromosomes in *Elephantopus scaber* Linn. has been found to be 18 (Fig. 1) and this, as far as the authors are aware, has been recorded for the first time. The normal root-tips were fixed in 1 : 3 acetic alcohol for 10 minutes and after a wash in distilled water, were treated with con. HCl for 1-2 minutes. They were washed again with distilled water, treated with 4% iron alum for 15 minutes, washed in distilled water and stained in aceto-orcein for 45 minutes. They were finally mounted in 45% acetic acid. The root-tip of *E. scaber* Linn. contains rare

containing 9 chromosomes and a tetraploid cell with 36 chromosomes (Fig. 3) have been sighted in the same root-tip. It is a general belief[1] that the frequency of occurrence of cells with viable haploid chromosome complement is much smaller than that of gene mutations. The occurrence of haploid cells in the diploid root-tips, which has been attributed to somatic reduction,[2] has been previously described in other plants and has been considered[1-6] to be a very rare phenomenon in diploids, though fairly common in polyploids.[7-11] This phenomenon of somatic reduction appears to be an enigma, even as the occurrence of aneuploid variations in chromosome number like 19 and 20 (Figs. 6 and 7) in the same root-tip of *E. scaber* Linn.

FIGS. 1-7

instances of haploid and tetrasomatic chromosome complements besides other variations in chromosome numbers. A haploid cell (Fig. 2)

The occurrence of tetrasomatic chromosome complement in the 'normal diploid root-tip suggests the inhibition of formation of spindle.

The slight aneuploid variations from the normal chromosome number are to be attributed largely to the mitotic abnormalities, occurring rather frequently in this plant. For instance, the commonest mitotic irregularities seen here are (1) the occurrence of chromosome laggards and (2) promiscuous distribution of chromosomes (Figs. 4 and 5).

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Strasburger   K. RANGASWAMI AYYANGAR.
Cytological Lab.,   R. SAMPATHKUMAR.
Department of Botany,
Annamalai University,
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SOME OBSERVATIONS ON *ANABAENA NAVICULOIDES* FRITSCH

THE present blue-green alga was isolated from a paddy field soil of the Ghazipur District of Uttar Pradesh, India. An interesting observation was made when a little inoculum of the alga from a four-month old cuture (grown in De's[1] medium, pH 7·00 ; temperature $28 \pm 2°$ C. ; light intensity 100 lux near the cultures) was transferred to a freshly prepared De's medium under identical cultural conditions. After a week, some new and unrecorded observations were made.

In certain young filaments, the terminal cell cuts off a small cell at the tip, in other cases, a cut-off small cell is seen disposed slightly to one side (Fig. 1) and in a few cases, the cut-off cell was observed attached on one side and the sub-terminal cell divides to form a new cell at the tip (Fig. 2). This gives an appearance of a true branch although an arrested one. Further growth of this stage could not be observed in spite of intensive search and close examination of the material.

Cutting off of terminal cell has been observed in other blue-green algæ including *Scytonematopsis woronichii* Kiss.,[2] *S. ghazipuresis* Pandey and Mitra[3] and others. The significance of such a formation is not clear. Recently,

FIGS. 1-2. *Anabaena naviculoides* Fritsch. Fig. 1. The filament shows a small cut-off cell at the tip slightly disposed to one side, × 2,200. Fig. 2. The filament shows the occurrence of a small true branch-like structure in which the cut-off cell is disposed to one side and the sub-terminal cell has divided to form another apical cell, × 2,800.

Singh[4] recorded the occurrence of true branches in a form of *Nostoc commune* Vanch. With the meagre evidence on record, the author feels hesitant to call this apical cutting as a 'true branch' but the phenomenon is very fascinating to merit further investigation to ascertain the real causes for this morphological behaviour.

Department of Botany,   D. C. PANDEY.
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REVIEWS AND NOTICES OF BOOKS

The Development of High-Energy Accelerators. Edited and with Commentary by M. Stanley Livingston. (Dover Publications, Inc., New York), 1966. Pp. xi + 317. Price $ 2.50.

This volume, together with others recently published in this new series, inaugurates a publishing program entitled *Classics of Science*. Each volume is a collection of fundamental essays and other basic original articles in a certain field of science, presented in the sequence of its development, together with an introduction, commentary, and clarifying notes by the scholar responsible for the selection of the papers. This book is the third volume of the series under the General Editorship of Gerald Holton, Harvard University.

The following topics have been dealt with in this book and the number of papers contained therein is twenty-eight by eminent authors in the respective fields : I. Direct Voltage Acceleration—Voltage Multiplier ; Electrostatic Generator ; II. Resonance Acceleration—The Cyclotron-Magnetic Resonance Accelerator ; Linear Accelerators—I ; The Betatron-Magnetic Induction Accelerator ; III. Synchronous Acceleration—Electron Synchrotron; Synchrocyclotron; Proton Synchrotron; Linear Accelerators—II ; and IV. Alternating Gradient Focusing—Alternating Gradient Synchrotrons ; Isochronous Cyclotron ; Note on Fixed Field Alternating Gradients (FFAG).

<div style="text-align:right">C. V. R.</div>

Completeness in Science. By Richard Schlegel. (Appleton-Century-Crofts, 440, Park Avenue South, New York, N.Y. 10016), 1967. Pp. xi + 280. Price $ 7.50.

The question of how far science can go in explaining the universe and in giving a guide to the total conduct of our lives is a popular question, often discussed in brief essays and in after-dinner speeches. In this book, the problem is considered in diverse ways : with the pragmatic consideration of what we want from science, with a view of the logical aspects of scientific description and theory, and with reference to what science has found to be the nature of our physical universe. Among the topics that are brought to bear on the basic theme are Godel's undecidability theorem, the meaning of infinity in mathematics and astronomy, the various contemporary cosmological models, and our understanding of nature and man's place in nature as given by modern quantum physics.

The author suggests a unifying element in the limitations of science as they appear in ordinary description, in logical and mathematical undecidability, and in the uncertainties of quantum theory. His study leads him to certain definite conclusions about the extent and limits of science. On the basis of these conclusions, he points to the role of such activities as art and religion in determining man's behavior and ultimate beliefs.

<div style="text-align:right">C. V. R.</div>

Linear Systems of Ordinary Differential Equations. By N. P. Erugin: (Academic Press, Inc., New York and London), 1966. Pp. xxi + 271. Price $ 12.00.

This book is devoted to a study of linear differential equations with periodic and quasi-periodic coefficients. Non-linear equations are also considered. Proofs of the existence of and methods for constructing bounded, unbounded, and periodic solutions of such systems are presented. Attention is paid to the importance of the theory of linear systems of differential equations. The theory of functions of matrices (the method developed by Lappo-Danilevskiy) is demonstrated. The ideas and methods of Liapunov are also treated. Important references to the Soviet literature are also included.

This book will be of interest to a broad group of mathematicians, scientific workers, physicists, engineers, and graduate students in mathematics.

<div style="text-align:right">C. V. R.</div>

Advances in Communication Systems : Theory and Applications (Vol. 2). Edited by A. V. Balakrishnan. (Academic Press, Inc., New York and London), 1966. Pp. xi + 328. Price $ 13.50.

This serial publication is designed to provide a permanent record of the latest theoretical and experimental developments in the field. It features mathematical theory as well as data on communication systems. Each contributor is a specialist in a specific area. The aim of each chapter is to place each new theory within the overall scientific scheme.

Volume 2 contains sections on: A Study of Multiple Scattering of Optical Radiation with Applications to Laser Communication; Stochastic Approximation—A Recursive Method for Solving Regression Problems; Optical Techniques in Communication Systems; Synchronous Satellite Communication Systems; Theory of Adaptive Data Compression; Manned Spaceflight Communication Systems; and Orbiting Geophysical Observatory Communication System.   C. V. R.

The Cytology of the Protein Synthesis in an Animal Cell. (Translated from the Russian). By B. V. Kedrovskii. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1967. Pp. xi + 462. Price $ 29.50 Cloth ; $ 14.50 Paper.

This volume describes the methods and results of Professor Kedrovskii's investigations of the synthesis of protein under conditions of oogenesis in Lepidoptera, revealing a number of cytological details and characteristics of protein synthesis of a more general significance. His investigations also cover the general processes of interaction of intranuclear structures and specifically with the role of the cell nucleus in protein synthesis.

Contents in Brief : Part I: Protein Synthesis and Its Condition in the Oogenesis of Lepidoptera : Stating the problem ; Material and Technique of the Investigation ; Chemical Changes and Structural Interactions in the Oogenesis of *Bombyx* ; Interaction of Structures in Oogenesis of *Deilephila* sp. ; Nucleus and Cytoplasm in Oogenesis of *Hemaris funciformis* L. ; Certain Additional Data Pertaining to the Oogenesis of Butterflies ; The Trophocyte-Oocyte System of the Lepidoptera Order in the Light of a Comparative Cytological Analysis. Part II : Interaction between Intranuclear Structures during the Protein Synthesis in the Animal Cell. Singnificance and Function of the Cell Nucleus : The Significance of Some New Methods in the Physiology and Biochemistry of the Cell ; Protein Synthesis in Oogenesis ; Conditions for Protein Synthesis in Somatic Cells in a State of Intensive Growth and Reproduction ; Localization and Conditions for the Synthesis of Intracellular Proteins ; Biochemistry of Protein Synthesis and the Role Played by the Chemical Components of the Cell ; Structure and Composition of Intracellular Cytoplasmic Elements and their Part in the Protein Synthesis ; Synthesis of Protein and Nucleic Acids in the Structural Elements of the Cell Nucleus ;

The Significance of the Nucleus for Cell Physiology and its Effect on Protein Synthesis in the Cytoplasm ; Passage of Nuclear Products into the Cytoplasm and Construction of the Nuclear Membrane ; Interaction between Cytoplasmic Structures in Protein Synthesis ; The Influence of the Cytoplasm upon the Function and the Protein-Nucleic Acid Metabolism of the Cell Nucleus.   C. V. R.

Wheat. By B. P. Pal. (Indian Council of Agricultural Research, New Delhi), 1966. Pp. x + 370. Price Rs. 18·50.

The Indian Council of Agricultural Research has been publishing a series of books on cereal crops. The present book under review is the fourth in the series. The author who has compiled this book has devoted nearly three decades to the study of wheat crop in India.

In this book he traces the history of the crop from prehistoric times to the present day. He has included information on every aspect of the wheat crop—from systematics and morphology to cytogenetics, genetics and breeding and agronomy to grain quality. Besides these, there are chapters on physiology, diseases, pests, implements and machinery, and marketing.

Taxonomic notes on the important wheat varieties of India have been separately given. The book is profusely illustrated and will be found useful in libraries which deal with agriculture and the agricultural sciences.   C. V. R.

Methods in Bremsstrahlung Research. By O. V. Bogdankevich and F. A. Nikolaev. (Academic Press, Inc., Publishers, 111, Fifth Avenue, New York, N.Y. 10003), 1966. Pp. 217. Price $ 9.50.

In researches on nucleus and nuclear reactions, the use of high energy nucleids as incident beam is more in vogue than the use of high energy gamma-ray photons. The chief reason for this lies in the experimental difficulties in photonuclear research associated with the apparatus and with the processes themselves. For one thing, in the latter one has to deal with small cross-sections and with a complex continuous photon spectrum.

However, theoretically photonuclear reactions should offer the best possibilities for the study of nuclear structure and, with developments in linear electron accelerators, betatrons and synchrotrons, the activity in this direction is bound to grow. There is enough literature on

photonuclear research devoted to the theoretical aspects of the subject. The same however cannot be said so far as the practical aspects are concerned. There exists a need for a compendium like the present one which can be used by practical workers.

The book discusses methods used in research conducted with a beam of bremsstrahlung radiation. It deals with the spectrum of the radiation, with methods used in absolute and relative intensity studies of a bremsstrahlung beam, methods for measuring and stabilizing the energy of accelerated electrons in circular accelerators, methods for measuring activation curves and calculations of photonuclear reactions, and some features of the electronic apparatus used in accelerators. The appendices, of about 50 pages, contain computer-calculated tables of bremsstrahlung spectra, and tables required for the calculation of cross-sections.

The book should be useful to scientists, engineers, and students who work with electron accelerators.   A. S. G.

High-Energy Batteries. By Raymond Jasinski. (Plenum Publishing Corporation, 227, West 17th Street, New York 10011), 1967. Pp. xv + 313. Price $ 17.50.

Many of the present military, space, and commercial requirements for packaged electrical power are exceeding the capabilities of traditional battery systems, designs, and configurations. As a result there has been renewed interest in the subject of electrochemical energy storage and energy conversion, in particular high-energy batteries and fuel cells. The volume outlines the basic principles and technology of batteries and related electrochemistry, with emphasis placed on high-energy systems. The book discusses the electrochemistry of battery discharge, aqueous electrolytes, non-aqueous electrolytes, inorganic and organic, electrochemical efficiency, weight factors, etc.

A. S. G.

Books Received

A Laboratory Manual for Agricultural Chemistry. By A. Sankaram (Asia Publishing House, Calicut Road, Bombay-1), 1966. Pp. 340. Price Rs. 10·00.

Technical Fundamentals of Electronics. By Heinz Graff (Asia Publishing House, Calicut Road, Bombay-1), 1966. Pp. 155.

Germanium (including radioactive isotopes of germanium). By V. I. Davydov. (Gordon and Breach, Science Publishers, New York 10011), Pp. 417. Price: Cloth $ 18.00.

Fascinating Problems in Organic Reaction Mechanisms. By Subramania Ranganathan. (Holden-Day, Inc., 500, Sansome St., San-francisco), 1967. Pp. 88. Price $ 5.00.

Augmented Plane Wave Method—A Guide to Performing Electronic Structure Calculations. By T. Lourks. (W. A. Benjamin, Park Avenue, New York), 1967. Pp. xiv + 256. Price $ 7.50.

A Concise History of Mathematics (3rd Revised Edition). By D. J. Struik. (Dover Publications, New York), 1967. Pp. x + 195. Price $ 2.00.

The Study of Biology. By J. J. W. Baker and G. E. Allen. (Addison-Wesley Publishing Co., Inc., London, W. 1), 1967. Pp. xv + 667. Price $ 9.75.

Methods in Computational Physics (Vol. 6) —*Nuclear Physics.* By Berni Alder, S. Fernbach and M. Rotenberg. (Academic Press, New York.), Pp. xiv + 303. Price $ 13.50.

The Physics of Modern Electronics. By W. A. Gunther. (Dover Publications, New York), 1967. Pp. x + 337. Price $ 2.25.

Mechanics of Materials. By A. Sloane. (Dover Publications, New York), 1967. Pp. xi + 468. Price $ 2.75.

Electric and Magnetic Fields. By S. S. Attwood. (Dover Publications, New York), 1967. Pp. xi + 475. Price $ 3.00.

Equivalent Circuits of Electric Machinery. By G. Kron. (Dover Publications, New York), 1967. Pp. xxviii + 278. Price $ 2.25.

Finite Deformation of an Elastic Solid. By F. D. Murnaghan (Dover Publications, New York), 1967. Pp. 140. Price $ 1.85.

Some Problems of Geodynamics. By A. E. H. Love. (Dover Publications, New York), 1967. Pp. xxvii + 180. Price $ 2.25.

Four Lectures on Relativity and Space. By C. P. Steinmetz (Dover Publications, New York), 1967. Pp. x + 142. Price $ 1.35.

Lectures on Quantum Field Theory. By P. A. M. Dirac. (Academic Press, New York), 1967. Pp. viii + 151. Price $ 7.50.

Let Us Start Here—An Introduction to Basic Reading in Life Sciences. By P. G. Roofe. (The World Publishing, Co., Cleveland), 1967. Pp. viii + 102. Price not given.

A NOTE ON THE PREVENTION OF CORROSION OF BRASS CONDENSER TUBES

N. SUBRAMANYAN, K. BALAKRISHNAN, PL. ANNAMALAI AND B. SATHIANANDHAM

Central Electrochemical Research Institute, Karaikudi

INTRODUCTION

IN equipment meant for the transfer of heat from one medium to another as in heat-exchangers or condensers, the condenser tubes are mostly made of copper-base alloys, like Admiralty metal and cupro-nickel, because of their high thermal conductivity and good mechanical strength. However, even such alloys are not exempt from corrosion, which can take different forms. Homogeneity of the tube-material is very important and among the brasses the 70% copper/30% zinc alloy is a single (alpha) phase solid solution[1] and is generally preferred to Muntz metal (60% copper/40% zinc alloy) which consists of two phases (alpha brass and beta brass) and is, therefore, more vulnerable to corrosion, though mechanically stronger than the single phase alloy.[2] However, even Admiralty brass containing 70% copper/29% zinc/1% tin is reported[3] to have occasionally undergone longitudinal splitting due to internal stresses. Aluminium-brass containing 2% aluminium in brass containing 76% copper is said to be used extensively in marine condensers and in steam condensers of tide-water power stations, where the high velocities of the circulating water and air-bubble impingement may have a severe wearing-out action on Admiralty metal and other brasses.[4] But the failure of aluminium-brass tubes also in condensers in a thermal power station has been reported[5] and some of the condenser tubes had developed longitudinal, transcrystalline cracks as shown in Figs. 1 and 2.

Among the methods for making condenser tubes resistant to corrosion, metallic coatings like tin, lead and chromium have also been mentioned.[6] Nevertheless, the most common practice is to employ corrosion-inhibitors in the water itself or in the condensate in steam-raising equipment, with the object of neutralizing the effects of carbon dioxide and removing oxygen in the system. Hydrazine is commonly used for the removal of oxygen, while morpholine and cyclohexylamine are generally used[7] for neutralizing, though of late, some film-forming amines like octadecylamine are reported[8] to be successfully used.

In view of the possibility that the amines, generally considered as inhibitors may themselves promote corrosion by release of ammonia under the conditions of high temperature and pressure prevailling in thermal power installations, a study of the effects of amines as corrosion inhibitors for copper and copper base alloys has been taken up. Some interesting preliminary observations made on the action of cyclohexylamine and morpholine on aluminium-brass in the course of this study are reported.

FIGS. 1–2. Fig. 1. Longitudinal cracks observed in the aluminium-brass heat exchanger-tubes of the Thermal Power Station at Dhuvaran. Fig. 2. Transcrystalline cracks of the aluminium-brass heat-exchanger tubes, × 1300.

EXPERIMENTAL

(a) *Steam-test.*—Aluminium-brass (Copper 76·11, Zinc 21·31 and Aluminium 2·38%) coupons of size 5 cm. × 1 cm. of 18 BWG cut from the heat-exchanger tubes obtained from the thermal power station of the Gujarat Electricty Board at Dhuvaran, pickled in dilute sulphuric acid for two minutes and polished with cloth buff were used. LR grade amines

and double distilled water were employed to prepare the corresponding solutions, which were then saturated with air. A copper boiler was used to heat the water-inhibitor mixture and the steam was taken through a glass-condenser tube cooled by circulating water with provision to hang the metal coupon in duplicate. Another specimen was suspended above the condensing column so as to expose it to steam before condensation. The condensate was manually transferred to the boiler at frequent intervals. At the end of the tests, the specimens were dried and photographed and later, the weight-loss

observed, that in the absence of the amine the surface of the specimen is only slightly tarnished, whereas with more amine contents the surface is tarnished increased rates, resulting finally in a film over the entire surface. The difference between a specimen exposed to condensate and that to condensate containing 0·1% cyclohexylamine is brought out in Fig. 3.

The corrosion rates of aluminium-brass steam condensates corresponding to different amine contents in the boiler-water are given in Table I.

TABLE I

S. No.	Composion*		pH	Condition	Weight loss in mg. 10 cm.² per hour
1	Steam		6·8	Dry	4·3
2	Steam		6·8	Condensate	2·6
3	Steam+0·001%	CHA	8·0	Condensate	2·9
4	Steam+0·005%	CHA	9·6	Condensate	2·4
5	Steam+0·1%	CHA	10·6	Condensate	11·0
6	Steam+0·1%	morpholine	8·9	Condensate	2·2
7	Steam+0·1%	morpholine	··	Dry	1·8
8	Steam+1·33%	morpholine	10·45	Dry	3·2
9	Steam+1·33%	morpholine	10·45	Condensate	9·0

* The amine dosages are with reference to the boiler-water.

was determined after cleaning them in 5% sulphuric acid.

(b) *Polarization Studies.*—Aluminium-brass coupons of the size 12 mm. × 12 mm. with a stem of 20 mm. were cut from the heat-exchanger tubes and mounted in a glass-tube. The unwanted area of the specimens was marked off with bee's wax-resin mixture or with Araldite resin. These electrode-specimens were prepared in the same manner as under (a) above. AR grade sodium chloride and LR grade (BDH) amines were used in preparing the solutions. The solution was saturated with oxygen before starting the experiment and the polarization was carried out in a Pyrex glass cell with suitable ground glass joints for introducing the platinum auxiliary electrode, the working electrode and the Luggin capillary tube to connect the reference electrode. The current needed was drawn from a 90 V battery through suitable high resistances in series and the experiments were carried out at room temperature ($\approx 35°$ C.).

RESULTS AND DISCUSSION

(a) *Steam-test*

At the end of 150 hours of exposure of the specimens to condensing steam, it is

Consistent with the surface-tarnishing, it be seen that the addition of excess of amines does not help in bringing down corrosion, but on the other hand, accelerate at increased concentrations, though the pH of condensate has been raised to values in range 8·0–10·6. This would indicate though the amines are able to take care of acidic constituent like carbon dioxide in steam or in the condensate, they may have deleterious effect on brass, perhaps, by the anodic dissolution in the presence of or oxygen.

The nature of the film on the specimen examined to see whether it was hydrophobic or hydrophilic. It was found that at all concentrations of cyclohexylamine employed the film was hydrophilic. But it was interesting to observe that in the case of morpholine a hydrophobic film was obtained at a concentration of 0·10%.

However, even with morpholine at high concentrations, the film formed was not hydrophobic (Fig. 4).

(b) *Polarization Studies*

Galvanostatic measurements.—The polarization behaviour of aluminium brass in 0·01

sodium chloride solution containing different amounts of cyclohexylamine (CHA) and

FIG. 3-4. Fig. 3. Aluminium-brass coupons. exposed to condensate. (i) Steam *plus* 0·1 % cyclohexylamine. (ii) Steam containing no amine. Fig. 4. Nature of the corrosion product on aluminium-brass after exposure to condensates containing amines. (1) 0·1 % CHA; (2) 0·1 % morpholine and (3) 1·33 % morpholine.

morpholine at room temperature are shown in Figs. 5 and 6. In the case of 0·005 % CHA, the anodic polarization behaviour is almost identical with that in sodium chloride whereas the cathodic polarization is slightly more than that in sodium chloride. When 0·1 % CHA is employed, only the anodic polarization is increased appreciably. In the case of morpholine the anodic polarization is enhanced to a much greater extent than in the case of CHA. The slight increase in cathodic polarization

observed (*see* Fig. 6) in the case of 0·1% morpholine disappears when the concentration

F G. 5. Anodic and cathodic polarization of aluminium brass in 0·01 N NaCl containing CHA. ⊙ → 0·01 N NaCl alone ; △ → 0·01 N NaCl + 0·005 % CHA ; ● → 0·1 % CHA.

FIG. 6. Anodic and cathodic polarization of aluminium brass in 0·01 N NaCl containing morpholine. ● → 0·01 N NaCl alone ; ⊙ → 0·01 N NaCl + 0·1 % morpholine , △ → 0·01 N NaCl + 1·0 % morpholine.

is increased to 1%. It may be noted that these polarization experiments carried out at room temperature do not correspond to the increased corrosion rate of aluminium-brass observed at higher concentrations of the amines in steam tests (as shown in Table I). This may, perhaps, be attributed to either the action of ammonia liberated by degradation of the amine or to the accelerated attack of the specimen by the amines at the higher concentrations. This aspect of the problem is being investigated.

CONCLUSION

The preliminary experiments reported in this note bring out the following points: (1) Even morpholine can form a hydrophobic film on condenser tubes at a concentration of 0·10%. (2) At concentrations of 0·1% CHA or of 1·33% morpholine, the corrosion of aluminium-brass

in the presence of air in the steam is more ... ... lower concentrations.

ACKNOWLEDGEMENT

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ROTATIONAL ANALYSIS OF SOME VISIBLE BANDS OF BiF MOLECULE

B. S. MOHANTY AND K. N. UPADHYA

Department of Spectroscopy, Banaras Hindu University, Varanasi-5, India

THE visible A-X band system of BiF has been investigated in emission in high frequency ... by Howell[1] and in absorption by Morgan.[2] Rao and Rao[3,4] have made rotational analysis of 9 bands, (0, 0), (0, 1), (1, 0), (0, 2); ... (2, 6), (1, 4), (2, 5) and (3, 3) of this ... by photographing them in the second ... of a 21 ft. concave grating spectrograph ... dispersion of 1·25 Å/mm. The present ... these bands was undertaken to deter-... more accurately the molecular constants ... BiF by recording them under higher dis-... and resolution.

The bands were excited in a hollow cathode ... Exposures of six to eight hours on

band is shown in Fig. 1. An inspection of the rotational structure of the bands reveals the presence of only two branches, P and R, well resolved even for low J values.

Rotational analysis of fifteen bands (0, 0), (0, 1), (1, 0), (0, 2), (0, 3), (1, 2), (2, 1), (2, 2), (3, 3), (1, 4), (2, 5), (3, 6), (3, 7), (2, 6) and (4, 7) have been made by fixing the absolute J numbering by the criterion suggested by Youngner and Winnans.[5] The combination differences for common level are correct to ± ·03 cm.$^{-3}$ The $\Delta_2 F(J)/J + \frac{1}{2}$ plot is quite smooth upto low J values. Rotational constants for these bands are given in Table I.

TABLE I

Band assignment	B_v' (cm.$^{-1}$)	B_v'' (cm.$^{-1}$)	D_v' (cm.$^{-1}$) $\times 10^{-6}$	D_v'' (cm.$^{-1}$)	ν_0 (cm.$^{-1}$)
0, 0	0·2090	0·2295	0·25	0·27	22892·13
0, 1	0·2090	0·2279	0·25	0·22	22384·10
1, 0	0·2082	0·2295	0·25	0·27	23269·35
0, 2	0·2090	0·2264	0·25	0·17	21881·00
0, 3	0·2090	0·2247	0·25	0·18	21382·25
1, 2	0·2082	0·2264	0·25	0·17	22257·65
2, 1	0·2075	0·2279	0·26	0·22	23130·55
2, 2	0·2075	0·2264	0·26	0·17	22627·75
3, 3	0·2070	0·2247	0·26	0·17	22492·10
1, 4	0·2082	0·2233	0·25	0·17	21264·99
2, 5	0·2075	0·2217	0·26	0·18	21145·10
3, 6	0·2070	0·2206	0·26	0·18	21023·50
3, 7	0·2070	0·2191	0·26	0·18	20543·25
2, 6	0·2075	0·2203	0·26	0·18	20660·41
4, 7	0·2065	0·2191	0·26	0·18	20901·75

$r' = 2·150$ Å; $r'' = 2·050$ Å.

... grating spectrograph with a dispersion ... Å mm. An enlargement of the (0, 0) ... Rapid Plates were sufficient to record these bands in the second order of a 35 ft.

FIG. 1.   Rotational structure of the 0, 0 band of the A–X system of BiF.

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SYNNEUSIS TWINNING IN PYROXENE

E. A. V. PRASAD AND M. G. CHAKRAPANI NAIDU

Sri Venkateswara University, Tirupati (A.P.)

THE Mid-Pennar Reservoir Project area (Long. 77° 20′ and 77° 25′; Lat. 14° 50′ and 14° 58′) in Anantapur District of Andhra Pradesh is traversed by dyke swarm cutting across granites, gneisses and amphibolites. A dyke near Ramapuram Temple has an exceptional width of about 200 feet. A small stream course running by the side of the temple cuts through the doletrite, laying bare for observation, the sharp and abrupt contact between the dyke and the granite. At the contact the dolerite shows chilled effects with variation in texture from extreme glassy type to increasing grain size inwards. Samples have been collected along a profile at regular intervals and detailed petrographic study has shown certain interesting results (Prasad and Chakrapani Naidu, 1966).[1] The significant feature revealed in this study, besides progressive increase in the grain size, is a general increase in the incidence of pyroxene twinning in contrast to the plagioclase twinning, from nearer the contacts of the dyke with the country rock towards the middle portion (Fig. 1).

The most striking and consistent feature in all the thin sections of the dyke examined is that the pyroxene twins occur in clusters (Fig. 2). They reveal the following characteristics :

1. There is no regular relation between the distribution of twin lamellæ and external morphological form.

FIG. 1.   Numbers of the samples taken along a profile from the contact towards the centre of dyke.
O — — —O   Variation in the frequency of twinned pyroxene.
O—·—·—O   Variation in the volume percentage of twinned pyroxene with respect to untwinned pyroxene.

2. They are associated with bending, twisting or fracturing of the crystal as is so common with secondary twinning.

3. The lamellæ are not regular and one or two lamellæ terminate abruptly within a crystal independently without showing any sysstematic distribution.

FIG. 2

4. The twinned grains clearly indicate stress or strain directed at certain portions and the crystals are not disturbed all along their projected continuation.

5. The gross outer form of the individual grains or the aggregates of twinned crystals also reveal the secondary nature of the pyroxene twinning.

Secondary twinning includes three types, *viz.*:

(*a*) Glide twins and

(*b*) Transformation twins of Buerger (1945)[2] and

(*c*) "Synneusis" or combination twins Ross (1957).[3]

The third type is much less widely appreciated and is not reported in pyroxene in the literature accessible to the authors; but this genetic type is clearly revealed and prominently displayed by the pyroxene twins in the middle parts of the dyke under study. In the thin sections examined the separate twinned grains are rare or absent. Invariably they occur in glomero-porphyritic clusters with individual twinned grains being in parallel, sub-parallel or random orientation. It appears that twinning behaviour, crystal habit and the nature of the crystal boundaries are affected differently by crystallisation of pyroxene in an essentially solid medium. The occurrence of pyroxene twins in clusters in progressively increasing number away from the contact of the dolerite towards its middle portions suggests that the pyroxene crystals in a solid state have undergone drifting together in an essentially fluid medium of the dolerite magma and combination of crystals to form twins.

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HUMAN SCHISTOSOMIASIS IN INDIA: DISCOVERY OF AN ENDEMIC FOCUS IN THE MADRAS STATE

G. SANTHANAKRISHNAN AND G. SUNDARA RAJULU

Department of Zoology, Thiagarajar College, Madurai-9

WORKERS in the field of parasitology had constantly kept in mind the possibility of the introduction of human schistosomiasis in India by Indian troops and travellers returning, after the first world war, from endemic areas. Sewell[1] observed that the snails belonging to the genus *Bulinus* and *Physopsis*, which were the usual vectors of this disease, did not occur in India. Hence it had been held that human schistosomiasis had no chance of being established in India. But authentic cases of this disease had been reported from time to time from widely scattered localities from Punjab, Poona, Bombay, Goa and Madras.[2-5] However, no endemic focus was discovered from India until recently when Gadgil and Shah[5] reported, for the first time, an endemic focus

from Bombay State. Now we have discovered an endemic focus from Madras State.

The endemic focus discovered by us is situated in a village called Tirupparankundram in Madurai District. The village has a population of about 3,000. The drinking water supply is from wells. Besides there is a large tank by name *Saravanappoigai*. The people of the village use the tank for washing after defecation and even discharge urine in it. They use the same water for washing clothes and bathing, thus affording ideal conditions for the spread of schistosomiasis which is a water-borne disease.

About 30% of the people of all ages, both males and females, of this village are suffering from urinary schistosomiasis. Hematuria with

or without typhoid fever is the symptom of the disease. Every sample of urine passed by the patients contained blood. The number of ova and eggs in their urine was so large that even uncentrifuged urine showed a fair number under the microscope. The eggs were oval with terminal spine (Fig. 1 A), resembling those of *Schistosoma hematobium.*[6]

FIG. 1. Egg and Cercaria of the Schistosome from Tirupparankundram. A: Egg; B: Cercaria,

Having thus established the presence of human urinary schistosomiasis, we turned our attention to the search of intermediate molluscan host. There are large number of snails in the tank referred to above. The snails are found submerged under water on the stones in the tank. A large number of snails were collected and dissected in the search for the larval stages of the schistosome. Of the 200 snails dissected, we found 90 were infected. The cercariæ discovered (Fig. 1 B) resembled those of *S. hematobium*. The infection rate in the snails is 45%.

The snails belong to the species *Vivipara heliciformis* (family Viviparidæ) as the shell is conical, scarcely umblicate, solid, smooth, polished and pale-olive green in colour; the number of whorls 6; the aperture is oval, somewhat angled above and interior of shell bluish-white in colour.[7]

It is suggested that detailed snail surveys in the areas from which stray cases of human schistosomiasis have been reported, may reveal some more foci of infection, and such discoveries will be of immense importance from the point of view of public health.

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RESPONSE TO SELECTION FOR WIDE ADAPTATION IN BREAD WHEAT

N. N. ROY AND B. R. MURTY
Division of Genetics, Indian Agricultural Research Institute, Delhi-12

CONFLICTING views have been expressed by various workers regarding the efficiency of selection under optimal and suboptimal conditions (Falconer,[1] 1960; Robertson *et al.*,[4] 1960; James,[3] 1961; Frey,[2] 1964). One of the drawbacks of selection under rainfed condition (low fertility) is the presence of high genotype-environment interactions preventing the identification of superior genotypes. Since germination and plant stands are poor under extreme moisture stress, maintenance of large segregating populations is a problem, while screening of genotypes is easy under favourable conditions for plant growth such as high fertility and optimum moisture.

Therefore, the efficiency and advance under selection in three diverse environments has been investigated in the present study to verify whether selection in favourable environments for some developmental features influencing yield will be useful in evolving lines with wide adaptation. The material consisted of the F_2's of a set of 17 crosses of wheat in a partial diallel involving 14 Indian and three exotics, genetically diverse elite parents. The same F_2 populations were grown under three different environments, *viz.*, high fertility (120 lbs. N/acre + irrigation (Irrigated), moderate (60 1 bs. N/acre + irrigation) and low (20 lbs. N/acre under rainfed condition) in 1965-66.

Among them, six crosses were chosen which were good for synchrony of tillering, vigour and population performance. Major emphasis was on synchronous tillering in all the three environments. Therefore, in respect of yield, norms were fixed for selection. The top 1·5% of the plants in each cross were chosen for carrying forward. In addition, an equal number of randomly chosen plants were also selected in each of the above six crosses. The progenies of these plants were grown during 1966-67 in the same three environments as mentioned earlier. These were tested in an additional environment also, i.e., low fertility + one protective irrigation. Out of the 84 single plants so chosen during 1965-66, 36 were from F_2's grown in high fertility, 24 from moderate and 24 from low. Their performance in each of the environments during 1966-67 is given in Table I.

TABLE I
Performance of 48 F_3 families of wheat in 1966-67 test based on the envionment of previous selection in 1965-66

Character	Environment (1966-67)	Number of best F_3 lines — Environment of F_2 selections			
		High (IRR)	Moderate (IRR)	Low (Rainfed)	Total
1. Seedling vigour	High (I)	18	8	8	34
	Moderate (I)	14	6	9	29
	Low (I)	13	9	9	31
	Low (R)	12	12	6	30
2. Synchronous tiller percentage	High (I)	8	6	3	17
	Moderate (I)	10	9	3	22
	Low (I)	8	8	2	18
	Low (R)	9	6	3	18
3. Survival at harvest	High (I)	12	5	6	23
	Moderate (I)	13	2	6	21
	Low (I)	8	5	10	23
	Low (R)	13	4	5	22
4. Yield	High (I)	13	5	4	22
	Moderate (I)	15	6	5	26
	Low (I)	11	5	7	23
	Low (R)	9	8	5	22

(I) = Irrigated   (R) = Rainfed

It is interesting that 77% of the families yielding best under barani (rainfed) condition are the progenies selected under high and moderate fertility with irrigation, and 80% of the vigorous lines under barani originated from selections made under high and moderate fertility. Out of the 22 populations which maintained good stand even under adverse condition of moisture stress, 59% of these were originally selected under high fertility. Similar was the case for synchrony of tiller development (Synchronous tiller percentage) with the highest contribution

(83·3%) of superior lines coming from high and moderate fertility. Considering over-all performance at all the four levels of environments of 1966-67, the same fourteen families were found among the top ranking ones in respect of yield on population basis. Among them 8 (57·1%) originated from high fertility, 4(28·6%) from moderate and 2(14·3%) from low. The yield differences between the random selections and conscious selections were not significant.

The correlations between the proportion of synchronous tiller number, i.e., synchronous tiller percentage (X_1) with total ear-tillers per plant (X_2), days to heading (X_3) and yield per plant (X_4) were estimated (Table 2).

TABLE II
Correlation coefficients of 4 associated characters in wheat at 3 different soil fertility levels

Characters	r value — High (IRR)	r value — Mod (IRR)	r value — Low (Rainfed)
X_1X_2 Synchronous tiller percentage and total ear-tillers/plant	− ·7114*	NS	NS
X_1X_3 Synchronous tiller percentage and days to heading	− ·7797*	− ·6233*	− ·6684*
X_1X_4 Synchronous tiller percentage and yield/plant	·5263*	·5438*	·5914*

NS.—Nonsignificant.   * Significant at 1% leval.

The value of X_1X_4 was significant and consistent at all the three environments indicating that synchrony in tillering is a major component of adaptation. Similar was the case for X_1X_3. The values of $\gamma_{X_1X_2}$ were variable depending on the environment. Therefore, recombinants with higher ear and tiller number and synchronous development can be obtained.

The data, therefore, point to the possibility of evolving lines which will perform well both under drought as well as high fertility by selection for developmental traits rather than yield alone. Further studies are under way on the associated changes in other characters with selection on the above criteria. This procedure appears to be of promise as a convenient method of breeding for drought resistance as well as wide adaptation.

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LETTERS TO THE EDITOR

EMISSION SPECTRUM OF 1-METHYL 9, 10-ANTHRAQUINONE VAPOURS

THE Eastman L.R. grade chemical of 1-methyl 9, 10-anthraquinone was excited by an uncondensed transformer discharge in the presence of flowing vapour of benzene. The experimental arrangement was similar to that described in our earlier paper.[1] The intense bluish glow was photographed by Fuess glass spectrograph in five hours using Kodak I-F plates.

The emission spectrum of the compound is shown in Fig. 1. It covers the spectral region

FIG. Emission spectrum of 1-methyl 9, 10-anthraquinone.

6935–4164 Å and shows its clear correspondence with the longest wavelength absorption system[2] (4195–3673 Å). The entire region of spectrum contains twenty-eight intense and diffuse bands.

The band at 23821 cm.[-1], which appears very prominently in the emission spectrum as well as in the absorption spectrum, is identified as the (0, 0) band. The emission spectrum has been analysed in terms of frequencies 307, 560, 941, 1383 and 1671 cm.[-1], all in the ground state. The companion bands with intervals of 60 cm.[-1] on the longer wavelength side of the main bands have been interpreted as due to v-v' transition. The assignment shows that the pure electronic band is shifted by 146 cm.[-1] towards the shorter wavelength side of the spectrum on 1-methyl group substitution in the anthraquinone molecule. The prominence of the C=O stretching frequency in progression as well as in combinations along with the shifting of the spectrum towards shorter wavelength

side shows the characteristics of the transition being of n-π^* type. The possible modes of vibrations for all the ground state frequencies observed during the present investigation along with the corresponding infrared values are presented in Table I.

The spectrum shows complete correspondence with the T-S emission of anthraquinone ($^3A_u \rightarrow {}^1A_{1g}$).[1] Thus under reduced symmetry C_s for its 1-methyl substituted derivative, the transition involved may be identified as ($^3A'' \rightarrow {}^1A'$). Such emission spectrum due to a triplet-singlet electronic transition does not seem unusual, because the lifetime of the molecule in the triplet state as measured from the phosphorescence emission 0·01 second is quite favourable[4] for this transition to be observed even in the vapour state.

TABLE I
Ground state frequencies of 1-methyl 9, 10-anthraquinone obtained from the emission spectrum

Emission spectrum	Infrared* spectrum	Modes of vibrations
307	..	a' C=O bending
560	..	a' skeletal deformation
941	942	a' skeletal deformation
1383	1382	a' C=H bending in CH_3 group
1671	1678	a' C=O stretching

* Author's unpublished work.

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Dept. of Spectroscopy, S. NATH SINGH.
Banaras Hindu University, R. S. SINGH.
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ON THE DETERMINATION OF INCOHERENT SCATTERING FUNCTION S (V)

THE deviation of the differential cross-sections for the incoherent scattering of gamma-rays from the Klein-Nishina predictions become significant for low energy photons and small scattering angles where the momentum transferred (q) to the electron is comparable with the momentum of the electron's motion within the atom. We have measured the values of incoherent scattering function S(V), which describes the effect of binding and motion of the scattering electrons for 145 keV gamma-rays and report the result in this letter.

FIG. 1. Incoherent scattering function S (V) as a function of V.

The experimental arrangement is similar to our earlier measurements.[1] Gamma-rays of 145 keV energy from Ce^{141} were scattered from targets of tin, iron, copper and aluminium in the form of circular annular rings. The scattering angle was varied from 3° to 16° by changing the source detector distance while keeping the scatterer in the centre. As the energy of the incoherent scattered gamma-rays is almost the same as that of the coherent scattered gamma-rays, the result obtained gave total cross-sections (incoherent + coherent). From the total cross-sections the accurately known calculated contributions of coherent scattering was subtracted. The ratio of the experimentally determined incoherent scattering cross-sections to the Klein-Nishina cross-sections gave the value of S(V). The results obtained are shown in Fig. 1 along with the theoretical[3-7] curves calculated for different electron distributions. The large errors at small value of V are due to the relatively large contribution of elastic scattering at small scattering angles.

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CHEMICAL COMPONENTS OF *DALBERGIA LANCEOLARIA* (FLOWERS AND LEAVES)

Dalbergia lanceolaria commonly known as Gaurakha is cultivated in the hilly areas of Mirzapur and Varanasi districts of U.P. in India. The leaves of this tree are used as a drug in the Indian medicine for the treatment of arthritis. Recent studies,[1] using animals and humans at Banaras, confirm that these leaves have beneficial effects in certain types of rheumatism and also possess anti-inflammatory properties. It has been reported that patients with serious lesions, where function of joints were completely impaired, have improved. We have therefore carried out a detailed chemical investigation of the leaves and flowers of *D. lanceolaria*.

Flowers.—Air-dried flowers (1 kg.) were successively extracted with light petroleum, acetone and alcohol in the soxhlet (64 hr. for each solvent). The light petroleum extractives were found to consist of waxy material. The green acetone and alcoholic extracts were found to contain the same components (T.L.C.); they were combined and concentrated to 300 ml. (approx). The concentrate when kept in the refrigerator for two days deposited a crystalline

solid (20 g.). This was boiled with methanol, filtered, and recrystallised from glacial acetic acid yielding a crystalline colourless solid, T.L.C. pure, m.p. 297–98°. It did not give any colour with alcoholic ferric chloride or Mg and HCl but when it was treated with sodium amalgam in ethanol, left overnight and acidified, a deep pink colour developed showing its isoflavone nature. It gave a deep blue colour when heated with gallic acid and concentrated sulphuric acid at 80° showing the presence of methylene-dioxy group ; u.v. spectrum $\lambda_{max.}^{MeOH}$ 256 mμ (log ϵ 4·67), 293 mμ (log ϵ 4·06). The above physical as well as chemical study revealed that the compound is ψ-baptigenin (7-hydroxy 3′, 4′ methylene-dioxy isoflavone). The identity was confirmed by the preparation of its methyl ether and acetate.

Leaves.—Air-dried leaves (800 g.) were similarly extracted with the above-mentioned series of solvents. The light petroleum extract gave only wax and chlorophyll. The acetone and alcoholic extracts gave ψ-baptigenin in quite high yields (2%). After removing it, the mother liquors were treated with neutral and basic lead acetates ; lead salts yielded quercetin and kæmpferol in low yields.

Since ψ-baptigenin was present in consider-able amounts in the leaves of *D. lanceolaria* it was considered desirable to test whether it could be the main compound responsible for the beneficial properties of the leaves in arthritic ailments. A large sample was sub-mitted to the Post-Graduate Institute of Indian Medicine and the report of tests[2] on animals and clinical trials on human patients confirm its potency.

Department of Chemistry,   A. MALHOTRA.
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EFFECT OF ADRENERGIC BETA RECEPTOR BLOCKING DRUGS ON RAT BRAIN 5-HT LEVEL

ADRENERGIC β-receptor blocking drugs possess important effects on the central nervous system. Propranolol has been reported to possess central depressant and muscle relaxant as well as antitremor actions.[6,7,2] N-isopropyl-β (4-methanesulphonamidophenyl) ethanolamine (MJ 1999) also possesses a depressant action on the brain.[5] A recent adrenergic β-receptor blocking agent *d-n*-isopropyl-*p*-nitrophenyl ethanolamine (*d*-INPEA), however, has central excitatory effect.[6] Propranolol[5] and *d*-INPEA (unpub-lished observation) inhibit monoamine oxidase (MAO) activity, *in vitro*. Since this enzyme is concerned with the destruction of 5-hydroxy-tryptamine (5-HT), an amine which might be concerned with the functional activity of the brain, the present work was undertaken to study the effect of adrenergic β-receptor block-ing drugs on brain 5-HT level in albino rats.

Propranolol, MJ 1999, *d*-INPEA or normal saline were injected intraperitoneally into albino rats (150–200 gm.). The animals were decapitated 1 hour later, after the behavioural effects of the drugs manifested, and their brains put in ice-cold acetone. 5-HT was extracted by the method of Amin, Crawford and Gaddum (1954)[3] and assayed on the rat stomach fundus by the method of Vane (1957).[8]

The effects of drug treatment on brain 5-HT level has been shown in Table I.

TABLE I
Effect of adrenergic β-receptor blocking drugs on rat brain 5-HT level

Drugs	Dose mg./kg.	No. of experiments	Brain 5-HT content μg./gm.	p value
Control ..	..	10	0·40	..
Propranolol	10	6	1·05	<0.05
MJ 1999 ..	80	6	0·92	<0.1
d-INPEA ..	80	6	0·45	>0.9

From Table I it may be seen that pro-pranolol and MJ 1999 cause a rise in brain 5-HT. These drugs have also been reported to depress the central nervous system. However, only propranolol has been shown to possess MAO inhibiting action. It therefore appears that the rise in brain 5-HT may be due to the non-specific depressant action. Such an effect has also been reported after other sedatives like barbiturates, meprobamate and morphine.[1] The greater increase in 5-HT after propranolol may be due to its additional enzyme inhibiting effect. *d*-INPEA, in spite of its inhibiting action on MAO *in vitro*, does not elevate brain 5-HT which could be due to lack of enzyme inhibition, *in vivo*.

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M.G.M. Medical College,   M. V. NATU.
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July 5, 1967.

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PECTIN *TRANS*-ELIMINASE ACTIVITY IN *CYTOPHAGA*

ALBERSHEIM, Neukom and Deuel[1] discovered the enzyme *trans*-eliminase in the commercial pectinase "Pectasin R-10". This enzyme splits a, 1-4 glycosidic bonds in pectin by a *trans*-elimination reaction and the product of its degradation has a characteristic absorption maximum at 230–235 mμ. Widespread distribution of this enzyme in bacteria, actinomycetes and fungi has been reported. Also, according to the substrate specificity exhibited, more than one enzyme have been recognised and these have been now designated as either pectin *trans*-eliminase[2] or polygalacturonic acid *trans*-eliminase.[3]

The presence of *trans*-eliminase activity in *Corynebacterium barkeri*, *Flavobacterium* sp., *Micrococuss* sp. and *Arthobacter* sp., has previously been reported from this laboratory. It was shown that several species of *Streptomyces* also exhibit pectin *trans*-eliminase activity. Interestingly, the enzyme was found to be produced even by protozoa. Recently, Agate, Jayasankar and Bhat[4] have traced the literature and discussed pectin *trans*-eliminase in detail in their review in this journal.

The present note deals with the detection of pectin *trans*-eliminase and polygalacturonic acid *trans*-eliminase in some *Cytophaga* species isolated from soil and water samples. Needless to state that pectinolytic properties have not been attributed to the species of this genus. Surprisingly, the culture filtrates of *Cytophaga deprimata*, *C. albogilva* and *C. johnsonii* failed to show pectin methyl esterase and polygalacturonase activity when tested by CaCl₂-gel formation and alcohol precipitation respectively; however, the culture filtrates revealed pectinolytic activity when tested by the cup-plate method described by Nagel and Vaughn.[5] The enzymes present in these species were charac-

terised to be pectin *trans*-eliminase and polygalacturonic acid *trans*-eliminase when tested by a method similar to that described by Nagel and Vaughn[6] which consisted of adding metabolic filtrate to a buffer substrate (pH 8·0) containing 0·001 M calcium chloride + pectin or polygalacturonic acid as substrates and examination of the reaction mixtures (after incubation for 24 hours at room temperature—25-27° C.) for their absorption spectrum in the range of 220–250 mμ. The reaction mixtures showed an absorption peak at 235 mμ. Confirmation of the finding was sought and indeed derived from the thiobarbiturate reaction of the break-down product, viz., digalacturonide which gave an absorption maximum at 548 mμ.[7]

The extent of decomposition of pectin by *Cytophaga* species was then determined by measuring the residual pectin in culture filtrates according to the method of Kaiser.[8] The decomposition ranged from 10 to 40% within 15 days (stationary cultures). Further work is in progress and, in the meantime, it is hoped that this first report on the *trans*-eliminase in the *Cytophaga* species would be of interest to the investigators on these bacteria as well as these enzymes.

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NOTE ON THE OCCURRENCE OF *OSTREA TALPUR* VRED., IN THE INTER-TRAPPEAN BEDS AT DUDDUKURU, NEAR RAJAHMUNDRY, A.P. *

THE note records the occurrence of *Ostrea talpur* Vred., a characteristic Lower Ranikot oyster from Sind (W. Pakistan) in the Inter-trappean Beds exposed about 1·5 Km. South-East of Duddukuru (17° 02′ 15″ : 81° 35′ 45″ ; 65 G./12), near Rajahmundry, Andhra Pradesh. The fossils occur in a 10 m. thick band of buff

to cream-coloured arenaceous limestone, which is being quarried about 0·4 Km. south of milestone 350 on the Duddukuru-Kovur road. The results recorded here have accrued from an examination of a small collection of these oysters made during 1960-61 field season by Shri T. N. Narasimhan, Geologist, Geological Survey of India.

The Inter-trappean Beds of Rajahmundry area are well known for a very long period and have been the subject of study by a number of workers. One of the earliest references on the Rajahmundry Inter-trappean fauna is by King (1880) and later Rao and Rao (1937 and 1939) reported some foraminifera and Charophyta. Pascoe (1963; p. 1383) records a number of algal remains reported by various workers from these beds.

The present note is of interest as it is the first record of a species from the Inter-trappean Beds which is identical with the early Tertiary species from Sind (W. Pakistan). Earlier, Rao and Rao (1937) reported one form of foraminifera, *viz.*, *Nonionina* (*Nonion*) sp., which they thought is apparently identical with Ranikot (Palæocene) form from Samana Range of Kohat (W. Pakistan). Thus the occurrence of *Ostrea talpur* Vred. in the Inter-trappean Beds of Duddukuru suggests that the fauna of these beds has Tertiary alliances and is closer to the fauna of the Tertiary of Western India and Sind than to the Upper Cretaceous fauna of Coromandal coast (*see* Pascoe, 1963; p. 1384). The Inter-trappean Beds of Duddukuru, therefore, represent the Lower Ranikot horizon and are of Palæocene age.

A brief description of *Ostrea talpur* Vred., of the Duddukuru Inter-trappean Beds is as follows : Shell medium, irregular, vertically elongate, inequivalve and thick ; left valve externally irregularly convex with angular ridges radiating from the umbonal region, internally shallow with pallial line corresponding to the edge of the body cavity and marked by short transverse pits evenly distributed throughout the length but more conspicuous near the cardinal region than at the opposite margin of the shell ; right valve flat or concave, externally ornamented with strong foliaceous crowded concentric lamellæ, pallial line running close to the body cavity and marked with crowded but evenly distributed conspicuous ridge-shaped crenulations. The specimens from the Duddukuru area differ from the Sind specimens in being smaller in size but possess the most characteristic feature of the

species, *i.e.*, "its strongly marked pallial pits and crenulations".

FIGS. 1-2. *Ostrea talpur* Vred., × 5/8. Fig. 1. Right valve (G.S.I. Type No. 18308), internal view showing ridge-shaped pallial crenulations. Fig. 2. Left valve (G.S.I. Type No. 18314), internal view showing short transverse pallial pits.

The author is grateful to Shri M. S. Balasundaram, Director, Southern Region, G.S.I., for his keen interest in this work and to Shri T. N. Narasimhan for entrusting him with the study of his interesting collection.

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A SHORT NOTE ON THE MICROCLINIZATION IN THE GNEISSOSE GRANITES OF THE AREA AROUND AMINGAON, KAMRUP, ASSAM

THE area under investigation forms a part of the Shillong Plateau (Lat. 26° 15′ N. and 26° 13′ N., Long. 91·38° E. and 91·48° E. Topo. sheet 78 N/12, Scale 1″ = 1 mile).

The rock formations are Archeans. Over considerable part of the area, the rocks are

gneissose granite with subordinate exposures of fine-grained granite and augen gneiss.

The author believes that the gneissose granites were the results of granitization of the ancient pelitic sediments. In support of this notion the phenomenon of microclinization is considered as one of the criteria. The results are represented by camera lucida diagrams.

It appears from the study of rock sections that the potash felspar (microcline) is later than and replaces plagioclase and quartz.

Relation between Potash Felspar and Quartz.—The textural relationship of quartz and microcline is that potash felspar smoothly but irregularly penetrates and sends rounded tongues into the quartz and, ultimately, encloses group of evenly rounded relics possessing same optical orientations (Fig. 1). Apart from this quartz exhibits rugged margins against microcline.

FIG. 1. Microcline crystals enclosing tabular crystals of plagioclase, biotite and grains of quartz in Fine-grained Granite, × 20.

Relation between Potash Felspar and Plagioclase.—The replacement relationship between these two felspars can be demonstrated by the following facts :

(i) the embaying and disintegration of large plagioclase plates (Fig. 2).

(ii) The enclosure by potash felspar of numerous small laths of plagioclase (Fig. 1). Wherever potash felspar and plagioclase are in contact, replacement relations are always suggested by the nature of the mutual boundaries.

Temperatures do not seem to have been high in these operations as indicated by the co-existence of acidic plagioclase and microcline (A. R. Gindy, 1952).

FIG. 2. The two principal plates of plagioclase are in optical contiuity and are irregularly embayed subdivide by potash felspar in gneissose granite. Note the small inclusions of quartz, biotite in the plagioclases, × 15.

From the above characters it is evident that microclinization is a very well-marked process. Development of microcline is attributed to the action of potash-rich emanations which soaked through the body undergoing replacement. Apparently the metasomatic process by which the new microcline developed led to a partly fluid stage, since orientation of its tabular biotite and plagioclase inclusions may be observed (*cf.* Fig. 1).

The association of microcline and albite also suggests that microcline has a different origin rather than magmatic. In support of this evidence we may quote Tuttle's (1952) observations on the said association. According to him "the probability of microcline and albite, of the composition found in many granites, crystallizing from a granitic magma is exceedingly remote. The association of relatively pure albite and microcline suggests temperature so low that an origin other than magmatic is indicated unless exolution can be shown to be operative". The question of exolution in the present instance cannot be envisaged, because the intergrowth is of very irregular nature and the proportion of the constituents in the intergrowth is also variable in different crystals of the same slice. Therefore, microclinization is considered to be due to metasomatic effect of the introduced materials. This fact may also be proved by observing the appearance of microcline in the basic igneous rock.

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INFLUENCE OF SALINITY AND TEMPERATURE ON THE METABOLISM OF A FRESH-WATER CRAB

IT is known that factors like temperature and salinity when taken together affect the activity and metabolism of animals differently than when each is considered separately.[1] This report deals with the metabolic response of the fresh-water field crab *Paratelphusa hydrodromous* to temperature in different salinities.

The oxygen consumption of twenty individuals was measured at four temperatures (20° C, 25° C, 30° C, and 35° C.) in different salinities (tap water, 25%, 50%, 75%, and 100% sea-water). Oxygen consumption was measured by Winkler's method.[3] The habitat temperature during the course of these experiments varied between 27°–29° C. The results are presented in Table I and Fig. 1 *a-e*.

TABLE I

Q 10 values of a 20·0 gm. crab as a function of salinity and temperature

Medium	Q_{10} values Temperature range			Cl gradient (medium-blood) mM/l
	20-25°C.	25-30°C.	30-35°C.	
Tap water ..	1·26	1·44	1·99	− 255
25% S.W.	1·28	1·44	1·68	
50% S.W.	1·24	1·00	2·37	+ 21·05
75% S.W.	1·11	1·10	1·86	
100% S.W.	1·80	1·61	1·77	+281

The oxygen consumption of *Paratelphus hydrodromous* increases with increase in temperature as in other poikilotherms. This occurs in all the salinities though it differs in magnitude. In tap water and in 100% sea-water the increment in oxygen consumption with the increase in temperature is greater than in other media. In the rest of the salinities only the two extreme temperatures affected the metabolism of the crabs markedly. This is also evident from the Q_{10} values (Table I). The Q_{10} values

in tap water and 100% sea-water for all temperature ranges are uniformly high. In 50% sea-water the Q_{10} values for extreme temperature ranges are high while the value for 20–25° C. range is low. It was shown that Cl⁻ ion gradient between the blood and the medium influences the metabolism of *P. hydrodromous*.[2]

FIG. 1. Weight regression lines of O_2 consumption of *P. hydrodromous* at different temperatures in various saline media. *a* to *e* tap water, 25%, 50%, 75%, and 100% sea-water, respectively.

——O——O——O—— 20° C.
– – – – – – – – – – 25° C.
———— ———— ———— 30° C.
——●——●——●—— 35° C.

In media where the Cl⁻ gradient between blood and medium is large (tap water and 100% sea-water) the effect of temperature on metabolism is more marked. In 50% sea-water, which offers smaller Cl⁻ gradient, the oxygen consumption does not show a marked change from

25° C. to 30° C. (which are close to the habitat temperature) and only the two extreme temperatures 20° C. and 35° C. affect the metabolism considerably.

I am grateful to Prof. K. Pampapathirao for his guidance during the course of these investigations. I thank Prof. B. T. Scheer of the University of Oregon, and Prof. M. Florkin of University of Liege, for helpful suggestions.

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A RECORD OF *DIONCHUS AGASSIZI* GOTO, 1899 (MONOGENEA: CAPSALOIDEA) FROM THE SUCKER FISH *ECHENEIS NAUCRATES* LINNAEUS FROM BAY OF BENGAL

THE history and distribution of the capsaloid genus *Dionchus* appear to be of unusual interest and significance both to the students of Monogenea and ichthyologists. Uptill now species of this genus have been considered to be restricted to the fishes of tropical West American region including West Indies. Certain remoras or sucker fish (Family : Echeneidæ), the cobias (Family : Rachycentridæ) and a jack (Family : Carangidæ) have been reported as hosts.[1] Ilan and Kohn[2] recorded *Dionchus remoræ* from the Israel coast of Mediterranean Sea. Koratha[3,4] considered the geographic distribution, and host specificity of this genus and discussed at length the possible relationship of the remora and cobia on parasitological grounds. Same information has been provided by Hargis[5] independently and Manter[6] reiterated that the parasitological evidence definitely indicates relationship of Rachycentridæ and Echeneidæ on which point ichthyologists debated.

We have recently obtained specimens of *Dionchus agassizi* from the gills of the sucker fish *Echeneis naucrates* caught off the coast of Waltair (Bay of Bengal). Although the infestation of the gills was light usually two or three specimens of variable sizes being present on each infected fish, it could be considered as a common parasite on the remoras of

Waltair coast. On one occasion six specimens were recorded from a single host. In the light of these facts our present ideas about the geographic distribution of this genus have to be considerably modified. The specimens measured 0·83-3·68 mm. in length and 0·20-0·56 mm. in width at the level of ovary. Body is elongate with a triangular anterior end (Fig 1). A prophaptor is represented by

FIG. 1

FIGS. 1 2. Fig. 1. *Dionchus agassizi* Goto, 1899 (Ventral view). Fig. 2. Anchor enlarged.

numerous gland cells which occupy the entire broad triangular anterior region and open

along the margin by way of long slender ducts. The disc-like opisthaptor is 0·136–0·27 mm. in diameter. It is provided with a pair of large, strong characteristically shaped anchors (Fig. 2) and 14 small slender marginal hooks. Mouth is subterminal situated at a distance of 0·12–0·29 mm. from anterior end and opens directly into a muscular spherical pharynx measuring 0·046–0·156 mm. in diameter. The intestinal cæca are simple, unramified and confluent posteriorly. There are two pairs of eye spots situated anterodorsal to pharynx. Genital pore is situated on the left body margin in level with posterior margin of pharynx. Genital atrium is well developed. There are two elliptical testes measuring 0·125–0·250 × 0·078–0·135 mm. in size situated in tandem in the middle of the body. Seminal vesicle is a long sinuous tube situated anterior to ovary and surrounded by numerous prostatic cells. The pretesticular ovary is U-shaped. Vitellaria are extensive, composed of large follicles extending from base of triangular anterior end to the termination of caeca, confluent posterior to testis and invading the intergonadal space. Mehlis' gland is large, formed of numerous gland cells surrounding the tubular ootype. Uterus is short. Eggs have not been observed.

The Monogenea of the shark suckers of the Indian coast do not seem to have attracted attention although other marine teleost parasites have been studied. The present record of the genus *Dionchus* is the first from India thus extending its range of distribution to the east. It should be remembered that remoras are of common occurrence in the tropical waters. The present communication may serve to stimulate investigators at different parts in the tropics to make an intensive search for the gill parasites of remoras as well as other fishes known to serve as hosts of *Dionchus*. This will help to augment our knowledge of the distribution and biology of this interesting genus.

We thank Prof. P. N. Ganapati for interest and encouragement. One of us (R. M.) thanks the University Grants Commission for the award of a fellowship.

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STUDIES OF HOUSE FLIES

I. Breeding of *Musca sorbens*, Wied.

THOMSON AND LAMBORN[1] reported that in Nyasaland, *Musca sorbens*, Wied. is entirely dependent throughout its life on man. "These feed greedily to repletion on blood, serum, serious exudates, ulcers, sores and also secretions from the eyes, nose and mouth. It lays its eggs in human fæces, breeding very freely, it derives moisture from human fæces and could thus take up many pathogens".

The common Indian house fly *M. domestica nebulo*, Fabr. has been bred and reared by Deoras[2] and Wattal et al.[3] *Musca sorbens*, Wied. is found in India along with *M. nebulo*, Fabr. but *M. sorbens*, Wied. has not so far been bred in the laboratory for experimentation in Public Health problems.

West[4] stated that large-scale investigations on the biology of this species would continue to be rare until new techniques are developed, the aim being primarily to eliminate the use of human fæces as an oviposition medium and early larval habitat. Hafez and Attia[5] tested several artificial media in an attempt to eliminate the use of human faeces for breeding *Musca sorbens*, Wied. in the laboratory.

During the present investigations, various media were tried for rearing and breeding of *Musca sorbens*, Wied. in the laboratory without using human fæces. The following is the summary of the successful technique in these studies.

Feeding medium.—Musca sorbens, Wied. adults were initially collected from drain areas of Haffkine Institute compound and Parel Village. They were later fed on the mixture of 25 gm. of milk powder, 5 gm. of yeast dissolved in 300 c.c. of water, 100 c.c. of sugarcane juice and 5 drops of 5% formalin (added to avoid the curdling of the milk). This medium was found useful for rearing and maintaining the colony.

Sugarcane was cut into strips. The strips were tied by a piece of thread round a cotton wad soaked in the above mixture and this bundle was kept in the fly rearing cage. The flies were attracted and a large number of eggs in clusters of 20–30 was laid into the crevices formed by the strips.

Eggs.—The fertile eggs are pearly white, and about 0·74 mm. The infertile eggs are translucent.

Larval Medium.—The eggs obtained as above were transferred to bottles containing a medium having 10% milk powder, 10% yeast and 2% agar. The larvæ fed, grew and pupated on the top crust of the medium. The pupæ were removed in the rearing cages for further development.

Larva.—The hatching of egg usually takes place in 18–24 hours. The maggot passes through three instars, moulting twice in the course of development. First moult takes place after 24–28 hours. Second instar requires

were reported earlier by Deoras *et al.*[6,7] The morphology and incretory activity of *Musca sorbens*, Wied. were not studied because it was found difficult to breed this species in the laboratory without eliminating human faeces. With our success at breeding of *Musca sorbens*, Wied. in the laboratory attempts were made to study the comparative morphology along with corpora allata transplantation with *Musca nebulo*, Fabr.

Patton[8] differentiated these flies by the outward differences of colouration. The morphological studies indicate the following differences showing that such studies are important to give a clear-cut differentiation in species (Table I).

TABLE I

Distinctive features of Musca sorbens, *Wied., and* Musca nebulo, *Fabr. (Ap. : 25)*

		Musca nebulo, Fabr.		*Musca sorbens*, Wied.	
1.	Size	Females 8 mm.		6·0 mm.	
		Males 6 mm.		5·0 mm.	
2.	Wing span	Length 6·0 mm.		5·0 mm.	
		Breadth 3·0		2·0 mm.	
3.	Chætotaxy	*a.* Acrostical bristles absent		They are present	
		b. Mesopleural bristles arranged in the group of 1, 7		Mesopleural bristles arranged in the group of 1, 1, 5	
4.	Pseudotracheal canals	30–31		22–23	
5.	Spindles on antenna	Dorsal 12		9	
		Ventral 7		6	
6.	Rectal papillæ	Length 0·27 mm.		0·35 mm.	
7.	Ovipositor rods	First dorsal rod bifurcated		First dorsal rod two separate pieces	
	Length	Dorsal	Ventral		
		1st 1·1 mm.	1·0 mm.	1·29 mm.	1·29 mm.
		2nd 1·0 mm.	0·9 mm.	1·19 mm.	1·19 mm.
		3rd 0·34 mm.	0·34 mm.	0·50 mm.	0·40 mm.
8.	*a.* Ovary, eggs in each	Number 40–60		10–15	
	b. Egg chamber	Length 0·44 mm.		0·74 mm.	

24 hours to 32 hours, and the 3rd larval stage lasts for 3 to 4 days since the time of egg laying. The larvæ start pupating afterwards.

Pupæ.—The entire process of pupation may be completed in 4–6 hours. The pupal stage lasts for 4 days. And the adults emerge on the 7th or 8th day.

Life-History.—The life-history was studied under laboratory conditions of temperature varying from 20·6 to 32·5° C. and relative humidity from 66 to 82%. From egg laying to adult emergence it took 7–8 days. The adults mature in seven days and then start laying eggs.

II. Comparative Morphology of *Musca sorbens*, Wied. and *Musca nebulo*, Fabr. and Heterologous Transplantation of Corpus Allatum

Results of studies on the morphology and incretory activity of *Musca nebulo*, Fabr.

Deoras and Bhaskaran[7] showed that the corpus allatum in *Musca nebulo*, Fabr., when transplanted in allatectomised females, induced egg development and fat metabolism in those flies.

Musca nebulo, Fabr. and *Musca sorbens*, Wied. are found in allied habitat. It was needed to be seen whether the tissue graft in these flies would take up in heterologous transplantation of corpora allata and whether the effect would be the same as observed by Deoras and Bhaskaran.[7]

The results indicate that though the foreign graft is taken up, there is no effect on the maturation of ova or fat metabolism by the heterologous transplantation in allatectomised females of these two species. This latter effect confirms the results of Vogt[9] seen in *D. melanogaster* and *D. fimibris*, and aptly reviewed by Scharrer.[10]

We are thankful to Messrs. Gohad, Patade and Vad for help in the collection of the flies, to Dr. Bhaskaran for suggestions, and to the Director, Haffkine Institute, for providing facilities.

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ISOLATION OF *NOCARDIA BRASILIENSIS* FROM SOIL

IN the course of studies on the natural habitats of human pathogenic fungi undertaken in this laboratory, *Nocardia brasiliensis*, one of the important etiologic agents of mycetoma was encountered in one of the soil samples examined from Gwalior. This finding is worth reporting in view of the fact that this pathogen has been infrequently reported from soil.[1-3] From India *N. brasiliensis* has been reported from cases of mycetoma in man[4] but apparently there is no record so far of its isolation from soil.

Samples of soil were collected in sterile 1 oz. screw-capped bottles from various sites (depth not exceeding 5 cm.) and studied by the paraffin bait technique. The details of the methods used in the isolation and identification of *Nocardia* species were the same as given in a previous paper.[5] Pathogenicity of the strain isolated was tested in white mice. Growth from 2 weeks old culture on 4 slants of Sabouraud's glucose agar incubated at 37° C. was scraped and ground to a fine suspension with 5 ml. of sterile normal saline. An equal amount of 5% sterile hog gastric mucin was added to the suspension. Twelve male mice were divided into three equal groups of four animals. They were inoculated intraperitoneally with 0·25 ml. in one group, with 0·5 ml. in the second group and with 1 ml. in the third group.

The solitary isolate of *N. brasiliensis* originated from one of the samples of garden soil collected in June 1966 from Gwalior, Madhya Pradesh. A brief account of the morphological and physiological characteristics and of pathogenicity of this isolate for laboratory animals is given below:

Colonies on Sabouraud's glucose agar (Fig. 1) were raised, folded and pale yellow, without

FIG. 1. Two weeks old colony of *Nocardia brasiliensis* on Sabouraud's glucose agar incubated at 37° C.

any diffusible pigment. Aerial mycelium was absent in very young cultures, but it appeared in about 2 weeks in the form of a white powdery crust. The organism proved to be gram-positive and acid-fast. A surface pellicle was produced in glucose broth. In dilute gelatin (0·4%) it produced globose colonies and gave a positive reaction with ninhydrin.[6] It hydrolysed casein, tyrosine, gelatin and starch but xanthine and hypoxanthine were not hydrolysed. It reduced nitrate to nitrite. It utilized citrate, pyruvate and succinate. Benzoate was not utilized. Acid was formed in glucose, galactose, inositol, mannitol, mannose and glycerol.

None of the 4 mice inoculated with 1 ml. of the suspension of *N. brasiliensis* survived more than 24 hours. From each of the remaining two groups of mice 2 animals were sacrificed after 1 week and the remaining two after 3 weeks. Lesions were found on the spleen, liver, kidney and peritoneum in all these animals. Histologically, these lesions were mostly in the form of circumscribed abscesses containing round,

oval and multilobulated granules (Fig. 2) which were gram-positive. The granules measured

FIG. 2. Section through the liver of a mouse inoculated intraperitoneally with *N. brasiliensis*, showing abscesses containing granules. Hematoxylin and eosin stain, × 70.

50–500 μ in size. *N. brasiliensis* was recovered in culture from the lesions.

Vallabhbhai Patel   P. V. Kurup.
   Chest Institute,   S. K. Mishra.
University of Delhi,   H. S. Randhawa.
Delhi-7, *May* 11, 1967.   (Mrs.) S. Abraham.

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A NOTE ON THE SPOROGENESES AND THE GAMETOPHYTES OF *LAUREMBERGIA HIRSUTA* (W. et A.) SCHIND.

The genus *Laurembergia* belongs to the family Haloragaceæ, tribe Halorageæ. The only embryological work on this genus is that of Bley.[1] Gamble[2] reported two species from South India, *viz.*, *L. brevipes* (W. et A) Schindler (= *Serpicula brevipes* W. et A) and *L. hirsuta* (W. et A) Schindler (= *Serpicula hirsuta* W. et A). The present note deals with the sporogeneses and the development of male and female gametophytes in *Laurembergia hirsuta*. A detailed paper on the embryology of this species will appear elsewhere.

Laurembergia hirsuta is a small, decumbent, branching herb. The flowers are axillary and arranged in dichasial clusters. They are mono-ecious, tetramerous, actinomorphic and epigynous. A group of 3-4 hypodermal archesporial cells is differentiated at each corner of the four-lobed young anther (Fig. 1). The latter

FIGS. 1-12. *Sporogeneses and the male and female gametophytes.* Fig. 1. T.S. of portion of anther showing the primary parietal layer and the sporogenous layer, × 650. Fig. 2. T.S. of portion of anther showing the tapetum and the microspore mother cells, × 430. Fig. 3. Fibrous endothecium, × 430. Fig. 4. Tetrahedral tetrad, × 650. Fig. 5. Decussate tetrad, × 650. Fig. 6. Three-celled pollen grain, × 650. Fig. 7. Young ovule showing the primary parietal cell and the sporogenous cell, × 430. Fig. 8. Young ovule showing the megaspore mother cell and two parietal cells, × 430. Fig. 9. Linear tetrad showing the functional megaspore and three degenerating ones, × 430. Fig. 10. Two-nucleate embryo sac, × 1,455. Fig. 11. Four-nucleate embryo sac, × 430. Fig. 12. Eight-nucleate embryo sac, × 430.

occasionally becomes 3-lobed due to the fusion of two adjacent microsporangia. The archesporial cells divide periclinally forming a primary parietal layer and a primary sporogenous layer (Fig. 1). The former by further periclinal and anticlinal divisions forms an endothecium, a middle layer and a glandular tapetum (Fig. 2). As the anther matures the tapteum and the middle layer degenerate, while

the cells of the endothecium develop fibrous thickenings (Fig. 3). The primary sporogenous cells divide to form the microspore mother cells. The latter undergo reduction divisions followed by simultaneous type of cytokinesis resulting both tetrahedral and decussate tetrads of microspores (Figs. 4 and 5). The pollen grains are 4- to 7-rupoidate and aspidote with thick exine and thin intine. They are shed at the three-celled stage (Fig. 6). The dehiscence of the anther takes place by means of two longitudinal stomia.

The ovary is inferior, tetracarpellate, syncarpous and tetralocular with a single anatropous, bitegmic and crassinucellate ovule in each locule. Only one ovule reaches maturity while the other three degenerate at different stages of development before fertilization. The hypodermal archesporium is usually single-celled (Fig. 7); occasionally two-celled archesporium is formed. The archesporial cell divides to form an outer primary parietal cell and an inner sporogenous cell. The former produces one- or two-layered parietal tissue, while the latter functions as the megaspore mother cell (Fig. 8). As a result of meiotic divisions of the megaspore mother cell a linear tetrad of megaspores is formed (Fig. 9). The chalazal megaspore functions further and its nucleus undergoes three successive divisions to form an eight-nucleate embryo sac of the Polygonum Type (Figs. 9-12). The two polar nuclei fuse in the centre of the embryo-sac to form the secondary nucleus. The antipodal cells degenerate after fertilization. A number of starch grains are seen in the mature embryo sac which may serve as the main source of nutrition to the embryo sac.

Dept. of Botany,   M. NAGARAJ.
Central College,   B. H. M. NIJALINGAPPA.
Bangalore University,
Bangalore-1, *June* 14, 1967.

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DEVELOPMENTAL VARIATION IN SEX EXPRESSION IN CASTOR (*RICINUS COMMUNIS*)

Ricinus communis Linn. is a monoecious plant with spikes having male flowers at the base, male and female flowers interspersed with each other at the middle region and only female flowers at the top. Quite often deviation occurs from this normal feature in the direction of dioecism; but dioecious lines are rare at the population level, owing, probably, to the rapid reversion from dioecious to monoecious state.

Monoecism, which is a normal habit of the species, also does not seem to be static inasmuch as it keeps continuously undergoing changes. In consequence there occurs a range of variation in sex morphology within the monoecious state flanked by complete pistillate and complete staminate condition at either extremity. The trend of variation within the monoecious state, however, mainly refers to the sex proportions and to the mode of their distribution within the spike and between the spikes within the plant. Hermaphroditism, though uncommon, is not altogether lacking in the species. Polygamous lines also occur periodically.

The polymorphic pattern in the development of sexual races in castor suggests the genetic control of polygenic nature in which, presumably, both major and minor genes are involved with a few or, probably, a constellation of them having modifying effects. The apparent fluctuation in the development of sex patterns may, therefore, relate to the differential magnitude of penetrance and expressivity of modifiers in accordance with the prevailing environment. Also, it may be partly accounted for by the lack of uniformity in the reaction of the members of the polygenic complex to a given environment which causes the nongenetic component of the variance in respect of the polygenic character to be more than that of its true genetic base (Li *et al.*, 1945; Jain and Jain, 1961; Kempanna, 1963). Moreover, the highly outbreeding habit characteristic of the species, a main source of natural variation through genic heterozygosity, creates considerable phenotypic instability leading to non-fixation of most of the types which, also, explains the fluctuations. The implication of all these factors, discussed above, could though considered to be of equal importance in determining the variation pattern in sex expression, it is rather difficult to apportion precisely the degree of responsibility to each one of them individually or in interaction.

Nevertheless, what is relevant here is the recognition of the sex variants, either of conventional system or of non-conventional system (these terms have been adopted from Shiffris, 1960). Shiffris (1960) recognised five categories. To this were added five more types by Kulkarni and Ankineedu (1966). However, many more supposedly new sex variants have

TABLE I

Types reported by Shiffris (1960)	Additional types reported by Kulkarni and Ankineedu (1966)	Additional types reported now by the present authors
1. Normal monoecious, apically interspersed with male flowers	(1 a) Normal monoecious, apically interspersed with pistillate flowers (topmost being male flower)	(1 b) Normal monoecious, terminal male flower (1 c) Normal monoecious, apically interspersed with male flowers, terminal being female (1 d) Normal monoecious interspersed with pistillate flowers in the lower portion (1 e) Normal monoecious, apically interspersed with male flowers, and at lower portion interspersed with female flowers, topmost being either male or female
2. Normal monoecious, terminal hermaphroditic (polygamous)	(2 a) Normal monoecious, hermaphroditic in the upper portion, topmost being male flower (polygamous)	(2 b) Normal monoecious, hermaphroditic in the upper region, topmost being female (polygamous) (2 c) Normal monoecious with hermaphroditic flowers in both the regions (polygamous) (2 d) Normal monoecious, apically interspersed with male and bisexual flowers, terminal being male flower (polygamous)
3. Pistillate 4. Pistillate with interspersed male flowers from base to top 5. Pistillate with bisexual flowers (observed in exotic and indigenous material) (Polygamous)		(4 a) Pistillate with interspersed male flowers at the lower region, terminal being hermaphroditic (polygamous) (5 a) Pistillate with interspersed male bisexual flowers at the upper region (polygamous)
	(6) Staminate (7) Staminate with interspersed female flowers from base to top (8) Staminate with bisexual flowers	(7 a) Staminate with interspersed female flowers at the upper region (7 b) Staminate with interspersed female flowers at the upper region, terminal being female (8 a) Staminate with all hermaphroditic flowers in the upper region (polygamous), terminal being hermaphroditic (8 b) Staminate with interspersed female and bisexual flowers in the upper region (polygamous) (8 c) Staminate interspersed with female flowers from base to the middle region and with hermaphroditic flowers at the upper region (polygamous)

come to light from a study of a 5 acre general maintenance and multiplication plot comprising Rosy, HC-6 and Gujarat mono spike varieties during 1966 *Kharif* season at the Regional Research Station, Raichur, Mysore State. The distinctness of these types to be reported could be seen from their comparison with the types enumerated in Table I.

By further investigation it is evident that the species has proved to be a potential source of spontaneous variation in the matter of sex expression since all the types described by the previous workers, particularly by Kulkarni and Ankineedu (*loc. cit*) who isolated them from the progenies of irradiated material, have been recorded in addition to obviously, new ones reported here. However, one exception was that no phenotype which was

pistillate interspersed with only bisexual flowers, recorded by the other two, was observed under Raichur conditions although a nearly similar variant with its male and bisexual flowers integrated into the pistillate background has been recovered in the present material.

Univ. of Agri. Sciences, G. N. KULKARNI.
 Bangalore-24, *June* 12, 1967. C. KEMPANNA.

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SOURCES OF RESISTANCE TO FROST IN *S. TUBEROSUM*

FROST is a problem for successful culture of potatoes in the sub-tropical plains of North-Western India, often causing serious losses in yield. The need for potato varieties with foliage resistance to frost is, therefore, apparent.

Resistance to frost has been reported in several wild *Solanum* spp.[1] and the studies, so far made, involve crosses of resistant species to tetraploid *S. tuberosum* varieties. It would, therefore, be interesting to see whether such a resistance could be located in segregates of inter-varietal crosses of *S. tuberosum* as well, and the transfer of genes for frost resistance simplified. The results of such a study are presented below.

Since drought and frost resistance appear to be correlated characters,[2] drought resistant segregates of the following two crosses involving commercial varieties and drought resistant hybrids were screened, under natural frost conditions, to pick up frost resistant types:

(*i*) Kufri Red × HB 829
     (Gladstone × Taborky) = HC Nos.
(*ii*) Up-to-Date × HC 303 = HD Nos.

Plants (350 seedling clones) were raised in glass-house during November, 1965. At about 8 weeks' age, in early January, they were removed to the open for recording the frost effect. Plants of the commercial varieties Up-to-Date and Kufri Red were used as controls. Temperature and humidity during the first week of January 1966 are given in Table I.

HC Nos.: 164, 507, 659, 701, 911, 991, 995 and 1006.
HD Nos : 3, 4, 5 and 9.

Resistant.—Only tender leaves near the growing point killed (Fig. 1).

FIG. 1. Three potato plants depicting highly resistant, resistant and susceptible numbers.

HC Nos.: 13, 38, 188, 228, 246, 491, 713, 992, 1025, 1070 and 1156.
HD Nos.: 7, 12, 15, 29 and 46.

Since the lowest temperature recorded during the potato crop, in the North-Western and Eastern India[3] is only − 2·2° C. and the conditions of testing for frost resistance were fairly rigorous in this experiment, the above-mentioned frost-resistant segregates are likely to resist the natural frost conditions in the plains also. These could, therefore, be used for incorporating the genes for frost resistance, in the present commercial varieties. In addition, hybrids HC 911, HC 995, HD 4 and HD 5 possess resistance to drought and have been yielding fairly well in the hills under long-day conditions.

TABLE I

Temperature (°C.) and humidity during 1st to 8th January, 1966

Dates			1st	2nd	3rd	4th	5th	6th	7th	8th
Temperature °C.	Minimum		3·2	3·0	0·4	−1·5	−0·8	0·5	1·0	2·4
	Maximum		9·5	9·6	11·5	1·5	3·8	6·5	8·8	8·8
Humidity %		..	50	50	92	98	50	56	52	15

The first visible effect of frost (killing of young leaves) was observed on 3rd January. Most of the foliage, in controls, was killed within the next of days. Majority of the hybrids were similarly affected. Those which remained unaffected or were only affected little were classified as highly resistant and resistant types respectively.

Highly Resistant.—Practically no sign of frost damage (Fig. 1).

Central Potato Research Institute,
Simla-1, *May* 3, 1967.

P. C. GAUR.
M. L. KHANNA.

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498

FLEA BEETLE MENACE TO WONDER RICE AT RAIPUR

Rice cultivation with non-photosensitive IR-8 (wonder rice, recently released) and Taichung Native-1 is aimed at increasing rice production. The flea beetle *Chœtocnema* sp. (Chrysomelidæ: Coleoptera) severely attacked 2-4 leaf stage seedlings from the third week of February 1967 at Raipur so that many dibbled seedlings died. It appears to be the pioneer menace to exotic varieties in India and abroad perhaps.

Under dry field conditions the beetles actively inflict damage at sunset through early morning and hide in soil when warm. In flooded fields, they cling on shady portions of plants throughout the day and may swim about 2″ even during copulation. The beetles lacerate fine streaks of less than 1 mm. breadth and usually 2-3 mm., frequently up to 10 mm. but rarely 17 mm. long. The streaks may be scattered or in concentrated patches in various leaf zones. Occasionally pinpoint fine streaks are produced. The maximum number of streaks was 42 per one-third leaf. Such leaves die in 2-4 days. In dibbled paddy the maximum damage prevailed during first three weeks demanding chemical treatment. The beetles continue causing negligible damage till harvest of paddy. It is reported similarly on hybrid sorghum.

TABLE I

Flea beetle infestation to exotic paddy varieties

Variety	Percentage infestation of			
	Transplanted (4-week old)		Dibbled (2-week old)	
	Plants	Foliage	Plants	Foliage
Taichung Native-1	100	64·9	85·36	57·15
IR-8-288-3	95	51·07	77·00	52·56

From Table I it may be concluded that the exotic varieties are highly susceptible to flea beetles. Seedling death was more in dibbled paddy as it was a fortnight younger and more tender than the transplanted. The severe attack of pest coupled with hot dry weather accelerated the death of damaged dibbled paddy.

Laboratory replicated feeding trials with 3rd and 4th leaf round the clock, continuously for 4 days revealed that a total average of 30·9 mm area was fed by a single beetle in 24 hours. Three to six and eight to fifteen beetles feeding for 24 hours completely streaked the first or second leaf and third or fourth leaf respectively of Taichung Native-1.

Death of first-second leaf stage seedlings on account of drying of its damaged foliage was confirmed in the laboratory. Such seedlings grew only if third shoot (tube) developed in 2-4 days before the death of first-second leaf. The death of seedlings was not so sudden when third or fourth leaf was damaged.

Assistant Rice Entomologist,   S. U. KITTUR.
Central Rice Research Station,
Raipur, *May* 20, 1966.

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NEW RECORD OF A BRACONID PARASITE, *APANTALES COLEMANI VIERECK.*, FROM THE LARVAE OF *EUPROCTIS LUNATA* WALKER

A LARGE number of castor hairy caterpillars, *Euproctis lunata* Walker, was collected from the fields during the months of July-August 1966 at Udaipur (Rajasthan). The larvæ were reared in the laboratory on castor leaves. It was observed that from 15% to 20% mature larvæ could not pupate. An examination of such larvæ revealed that their abdomens were eaten up and they contained small white-coloured silken cocoons. After a period of 10 to 12 days, which was found incidentally equal to the pupal duration of the pest, small hymenopterous insects emerged from the latter. They were identified as *Apantales colemani* Viereck.

There is so far no record of *A. colemani* parasitising the larvæ of *E. lunata*; the present report therefore serves as the first record of the parasite attacking this pest.

The author is thankful to the authorities of British Museum, London, for identifying the parasite.

Entomology Research Division,   S. N. PANDEY.
Agricultural Experiment Station,
University of Udaipur,
Udaipur, *June* 16, 1967.

REVIEWS AND NOTICES OF BOOKS

Elements of Mathematics—General Topology.
By Nicolas Bourbaki. (Addison-Wesley Publishing Co., Inc., 10-15, Chitty Street, London W. 1), A translation of *Elements de Mathematique, Topologie Generale,* originally published in French by Hermann, Paris.
Part I: 1966. Pp. vii + 437. Price $ 18.50.
Part II: 1967. Pp. iv + 364. Price $ 18.50.

This series of volumes, a list of which appears in Part I, takes up mathematics at the beginning, and gives complete proofs. In principle, it requires no particular knowledge of mathematics on the reader's part, but only a certain familiarity with mathematical reasoning and a certain capacity for abstract thought. Nevertheless, it is directed especially to those who have a good knowledge of at least the content of the first year or two of a university mathematics course.
Part I contains the following chapters: I. Topological Structures; II. Uniform Structures; III. Topological Groups; and IV. Real Numbers.
Part II contains the following chapters: V. One-parameter Groups; VI. Real Number Spaces and Projective Spaces; VII. The Additive Groups Rn; VIII. Complex Numbers; IX. Use of Real Numbers in General Topology; and X. Function Spaces.   C. V. R.

Glass Electrodes for Hydrogen and Other Cations. Edited by George Eisenman. (Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016), 1967. Pp. xii + 582: Price $ 24.75.

The modern glass electrode today can be regarded as a family of glass compositions that are generally cation-sensitive, and of which the classical pH glass electrode is an extreme member. Hence this book deals with the treatment of the theory and practice of the use of membrane electrodes (particularly glass electrodes for the specific measurement of ions). Detailed information on the method of electrode fabrication and construction as well as on the instrumentation to be used with electrodes is presented. This work will be valuable to chemists, medical researchers, biologists, and engineers interested in the electrometric measurement of ion activities and is written by recognized authorities in each of the areas covered.

The titles of the articles contained in this book are listed below: 1. Introduction; Part I: Principles; 2. Interpretation of pH and Cation Measurement; 3. The Dependence of Glass-Electrode Properties on Composition; 4. Diffusion Potentials in Glass; 5. The Origin of the Glass-Electrode Potential; 6. Recent Developments in the Ion-Exchange Theory of the Glass Electrode and Its Application in the Chemistry of Glass; 7. The Physical Basis for the Ionic Specificity of the Glass Electrode; Part II: Practice; 8. The Construction of Glass Electrodes; 9. Particular Properties of Cation-Selective Glass Electrodes Containing Al_2O_3; 10. Anion-Specific and Cation-Specific Properties of the Collodion-Coated Glass Electrode and a Modification; 11. Glass Electrodes for Calcium and other Divalent Cations; 12. Cation-Sensitive Glass Electrodes in Analytical Chemistry; 13. Ion-Sensitive Electrodes and Individual Ion Activity Coefficients; 14. Glass Electrodes for Soil Waters and Soil Suspensions; 15. Hydrogen and Cation Analysis in Biological Fluids *in vitro*; 16. H and Cation Analysis of Biological Fluids in the Intact Animal; 17. Cation-Selective Microelectrodes for Intracellular Use; and 18. Glass Microelectrodes and Their Uses in Biological Systems; 19. Clinical Application of Cation-Sensitive Glass Electrodes.   C. V. R.

Reports on Progress in Physics (Vol. XIX).
Parts I and II. Edited by A. C. Stickland. (The Institute of Physics and the Physical Society, 47, Belgrave Square, London, S.W. 1), 1966. Price £ 5. 5 *sh.* (£ 2.2 *sh.* to Members) each including postage.
Part I: Pp. 372.
Part II: Pp. 373 to 756.

The Reports on Progress in Physics are under the general supervision of a special Editorial Board of the Publications Committee of the Institute of Physics and the Physical Society.

All reports published in the volume are also issued as individual articles. Information may be obtained from the offices of the Institute and Society.

The Cumulative Index of authors and subjects for Volumes XXI-XXV is also available as a separate reprint.

Volume XIX, Part I, contains the following articles: The Physics of High Temperature Creep

in Metals; Plasma Spectroscopy; Nuclear Reactions; Isotope Shifts and Nuclear Charge Distributions; The Dynamics of a Crystal Lattice with Defects; The Fluctuation-Dissipation Theory; Spin Waves in Ferromagnets; and Microscopic Transport Phenomena in Liquids.

Volume XIX, Part II, contains the following articles: Resonant Scattering of Electrons by Atomic Systems; Type II. Superconductors; The Origin of the Elements; Cosmological Models and Their Observational Validation; Plasma Oscillations; Covalent Ponding and Magnetic Properties of Transition Metal Ions; and Two-Beam Interferometric Spectroscopy.

C. V. R.

Radiation Measurements in Nuclear Power. Edited by Dr. A. C. Stickland; assisted by Miss M. E. Hilton. (The Institute of Physics and The Physical Society, 47, Belgrave Square. London. S.W. 1), 1966. Pp. viii + 455. Price £ 5 Post free in U.K. (U.S. $ 15.00).

This volume contains the 45 papers presented at the International Conference held at Berkeley, Gloucestershire, from 12th-16th September, 1966. Edited accounts of the discussions which took place have been prepared by Session Secretaries and these are also included. The Conference was organized by the Central Electricity Generating Board in collaboration with the Institute of Physics and the Physical Society. The Proceedings have been published by the Institute of Physics and the Physical Society.

The titles of the major subjects dealt with in this volume are listed below: 1. Role of Radiation Measurements in Nuclear Power (Invited Papers); 2. Thermal Neutron Measurements; 3. Fast and Epithermal Neutron Measurements. 4. Interpretation of Indirect Spectral Measurements; 5. Absolute Methods and Calibration; 6. Data and Data Handling; and 7. Measurement Techniques.

C. V. R.

Annual Review of Physiology (Vol. 29). Edited by Victor E. Hall. (Annual Reviews, Inc., Palo Alto. California 94306, U.S.A.), 1967. Pp. vii – 652. Price S 8.50 (U.S.A.) and $ 9.00 (elsewhere).

Volume 29 of this well-known series contains the following articles: Prefatory Chapter: An Old Professor of Animal Husbandry Ruminates; Transport through Biological Membranes; Growth and Differentiation; Comparative Physiology Metabolism; Respiration; Gastric Juice and Secretion; Physiology and Variations

in Disease; Comparative Physiology; Invertebrate Excretory Organs; Lymphatic Lymphoid Tissues; Systemic Circulation Heart; The Adenohypophysis and Its Hypothalamic Control; Parathyroid Hormone; Reproduction; The Nervous System at the Cellular Level; Central Nervous System: Afferent Mechanisms and Perception; Hearing; Visual Processes in the *Limulus* Eye; Higher Functions of the Central Nervous System; and Central Nervous System: Motor Mechanisms.   C. V. R.

Annual Review of Psychology (Volume 17). Edited by P. R. Farnsworth. (Annual Reviews, Inc., 231, Grant Avenue, Palo Alto, California 94306, U.S.A.), 1966. Pp. ix – 566. Price $ 8.50 per copy (U.S.A.) and $ 9.00 (elsewhere).

The articles contained in this volume are as follows: Developmental Psychology; Psychotherapeutic Processes; Counseling; Psychological Deficit; Cognitive Functions; Engineering Psychology; Perceptual Learning; Status of Japanese Experimental Psychology; Audition; Somesthetic Senses; Color Vision; Brain Functions; Personnel Management; Statistical Theory; Psycholinguistics; Attitudes and Opinions; and Behavioral Genetics.   C. V. R.

1. **The Study of Biology.** By Jeffrey J. W. Baker and Garland E. Allen. (Addison Wesley Publishing Co., Inc., 10-15, Chitty Street, London, W. 1), 1967. Pp. xv – 667. Price $ 9.75.

2. **Experiments in the Study of Biology.** By Jeffrey J. W. Baker and Garland E. Allen. Addison Wesley Publishing Co. Inc., 10-15, Chitty Street, London, W. 1), 1967. Pp. vi – 58. Price $ 1.95.

An excellent introductory book on biology, clearly written, elaborately illustrated and beautifully produced. It discusses all modern trends in biology and life science such as evolution, heredity, molecular biology, energy transformation, development ecology and the dynamics of animal and plant function.

Besides the beginning students of biology the book is sure to interest the lay reader with a scientific bent of mind. To him a perusal of the book will be an education in itself.

The second book *Experiments in the Study of Biology*, containing outlines of ten basic experiments, is designed as a companion laboratory manual to the above text-book.   A. S. G.

Germanium (Translated from Russian). By V. I. Davydov. (Gordon and Breach, Science Publishers, 150, Fifth Avenue, New York, N.Y. 10011), 1967. Pp. 417. Price $18.00.

Semiconductors have become the bases of technological progress in the fields of automation, high frequency radio engineering, and current transformation. One of the key positions among semiconductors is occupied by germanium.

The publication under review which is one of the *Russian Monographs and Texts on the Physical Sciences* published by Gordon and Breach, is a thorough book on the subject. It gives all about germanium, its minerals and ores, its metallurgy and recovery, production of high-purity germanium, physical, chemical and electrical properties of germanium and its compounds, etc. The volume also includes a chapter on Radioactive Isotopes of Germanium by N. P. Rudenko and L. V. Kovtun. A notable feature of the publication is that it is printed in big easy-to-read types, with a large number of tables and charts. A. S. G.

Fascinating Problems in Organic Reaction Mechanisms. By Subramania Ranganathan. (Published by Holden-Day, Inc., 500, Sansome Street, San Francisco), 1967. Pp. 88. Price $5.00.

This book is a compendium of 243 chemical problems in organic reactions, selected from recent literature (mostly between 1960–1965), to illustrate the devious pathway a reaction can take leading to an unexpected product. Each problem is in the form of a structural chemical reaction formula, indicating the starting material, conditions of reaction, and the final product. References to pertinent literature are given under each problem to enable the solver to verify his solution.

The problems will provide entertainment to an organic chemist who would like to enjoy a busman's holiday. Besides its entertainment value the book may stimulate research in serious students as none of the problems is trivial, and many are searching indeed. A. S. G.

Advances in Inorganic Chemistry and Radio-Chemistry (Vol. 9). Edited by H. J. Emeleus and A. G. Sharpe. (Academic Press, Inc., Publishers, 111, Fifth Avenue, New York), 1966. Pp. 386. Price $15.50.

The volumes serially published in this series give surveys of latest developments in different fields of activity in Inorganic Chemistry. They are sure to stimulate further researches in the fields concerned. The contents of Volume 9 are as follows : (1) Liquid-Liquid Extraction of Metal Ions, by D. F. Peppard ; (2) Nitrides of Metals of the First Transition Series, by R. Juza ; (3) Pseudohalides of Group III B and IV B Elements, by M. F. Lappert and H. Pyszora ; (4) Stereoselectivity in Co-ordination Compounds, by J. H. Dunlop and R. D. Gillard ; (5) Heterocations by A. A. Woolf ; and (6) The Inorganic Chemistry of Tungsten by R. V. Parish. A. S. G.

Books Received

Industrial Chemistry (Technology of Indian Chemical Industries). By R. C. Battacharjee. (Inter-University Press, P. Ltd., Educational Publishers, 1, Ansari Road, Daryaganj, Delhi-6), 1967. Pp. 218. Price Rs. 15·00.

Some Theory of Sampling. By W. E. Deming. (Dover Publication, New York), 1966. Pp. xvii + 602. Price $3.50.

An Introduction to Astrodynamics (2nd Edition). By R. M. L. Baker Jr., M. W. Makemson. (Academic Press, New York), 1967. Pp. xiii + 439. Price $11.75.

Principles of Osmotic Phenomena. By J. F. Than. (Royal Institute of Chemistry, 30, Russell Square, London, W.C. 1), 1967. Pp. 68. Price 8 sh.

The Chemistry of Lignin. By I. A. Pearl. (Marcel Dekker, Inc., 95, Madison Avenue, New York 10016), 1967. Pp. xii + 339. Price $15.75.

Experimental Techniques in Physical Metallurgy. By V. T. Cherepin, A. K. Mallik. (Asia Publishing House, Bombay-1), 1967. Pp. xi + 428. Price Rs. 30·00.

Russian English Translators Dictionary—A Guide to Scientific and Technical Usage. By M. G. Zimmerman. (Plenum Press, New York), 1967. Pp. 293. Price $12.00.

Recent Advances in Biological Psychiatry (Vol. IX). Edited by J. Wortis. (Plenum Publishing Corporation, New York 10011), 1967. Pp. xii + 377. Price $6.50.

Elementary Calculus from an Advanced Viewpoint. By G. B. Thomas Jr., J. K. Moulton and M. Zelinka. (Addison Wesley Publishing Co., Inc., London, W. 1), 1967. Pp. ix + 338. Price $9.50.

Award of Research Degrees

Andhra University has awarded the Ph.D. degree to the following : Sri. D. S. Somayajulu (Physics); Sri. G. Sitarama Sastry (Chemistry); Sri. K. Venkataratnam (Geology).

Sri Venkateswara University has awarded the Ph.D. degree in Zoology to Smt. P. Indiramma.

The Utkal University has awarded the Ph.D. degree in Chemistry to Shri K. C. Dash.

The Indian Society of Theoretical and Applied Mechanics—Twelfth Congress

The twelfth Congress on Theoretical and Applied Mechanics will be held under the presidentship of Dr. V. M. Ghatage, Deputy General Manager, Hindustan Aeronautics, Ltd., Bangalore, from December 18 to 21, 1967, at the Indian Institute of Technology, Delhi, Hauz Khas, New Delhi-29, India.

Research papers for the Congress may be on the following subjects : (*i*) Mechanics of Solids ; (*ii*) Mechanics of Fluids ; (*iii*) Statistical Mechanics ; (*iv*) Mathematical Methods ; (*v*) Computation Methods ; and (vi) Experimental Techniques.

Forms for Registration and other information may be obtained from the Office of the Secretary at the Indian Institute of Technology, Delhi-29.

Institution of Chemists (India) Associateship Examination, 1968

The Eighteenth Associateship Examination of the Institution of Chemists (India) will be held in November, 1968. The last date for Registration is 30th November, 1967. The Examination is recognised by the Government of India as equivalent to M.Sc., in Chemistry for purposes of recruitment of Chemists.

Further enquiries may be made to the Honorary Secretary, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Conference on Thermal Conductivity

The Seventh Conference on Thermal Conductivity will be held at the National Bureau of Standards, Gaithersburg, Maryland, on November 13–15, 1967. This Conference will be concerned with all aspects of heat conduction in solids, liquids, and gases. The subject-matter will include, but not necessarily be limited to : theoretical studies of heat conduction ; correlation of experimental data and theory ; new or improved methods of measuring conductivity or thermal diffusivity ; new data on potential standard reference materials ; new data on materials of general interest ; thermal contact conductance ; review papers

on any of these topics ; and instrumentation, temperature measurement, sample characterization, or other topics clearly related to thermal conductivity.

Abstracts deadline ; earliest possible date. Contact : D. R. Flynn and B. A. Peavy, Building 226, Room B 114, National Bureau of Standards, Washington, D.C. 20234.

Symposium on 'Ground and Lake Water Resources in India'

The Indian Geophysical Union, with the support of the National Institute of Sciences of India and the Indian National Committee for the Hydrological Decade, is organising a Symposium on 'Ground and Lake water Resources in India' in the last week of December 1967 in Hyderabad. The Symposium will be devoted to the studies connected with the hydrology of lakes, reservoirs and the underground water in India. The geological and geophysical investigation for locating water, hydrological aspects of ground-water including water in lakes and reservoirs, their origin, economics and scientific uses will be broadly discussed in the Symposium. Intending participants are requested to send abstracts of their papers, not exceeding 500 words, to reach the Secretary, Indian Geophysical Union, Hyderabad, not later than 1st October 1967. The full text of the paper in duplicate should reach him by 1st December 1967

Electrochemistry Eighth Seminar

The Central Electrochemical Research Institute, Karaikudi, is organising the Eighth Seminar on Electrochemistry during December 26-29, 1967, at Karaikudi. The following technical sections are scheduled to be held :

1. Electrode Kinetics, Electrochemical Equilibria and Electroanalyses. 2. Solid State Electrochemistry. 3. Corrosion. 4. Electrodeposition and Metal Finishing. 5. Batteries. 6. Electro-organic and Electro-inorganic products. 7. Electrothermics and Electrometallurgy. and 8. Techno-Economic Aspects of Electrochemical Process.

Abstracts (not exceeding 300 words) in triplicate of papers may be sent to Dr. P. B. Mathur, Convener, 8th Seminar on Electrochemistry, CECRI, Karaikudi-3 (S. Ry.), before 10th October 1967 and the full paper in duplicate before 10th November 1967.

SPECTRA OF 1, 4-DIHYDROXYANTHRAQUINONE IN INFRARED AND OPTICAL REGION

G. D. BARUAH AND R. S. SINGH

Department of Spectroscopy, Banaras Hindu University, Varanasi-5

INTRODUCTION

QUINONES are regarded as important compounds due to their antibiotic and colouring properties. Anthraquinone has recently been studied in the vapour phase.[1] The present work deals with the infrared, visible emission and absorption spectra of Quinizarin which is obtained by substituting OH radicals in the 1 and 4 positions of Anthraquinone. The infrared spectrum reveals many interesting features due to the formation of hydrogen bonding leading to the suppression or modification of various frequencies. The intramolecular hydrogen bonding in the hydroxylic compounds and in the field of anthraquinone has been investigated by Flett[2] and the chelated hydroxyquinone by Hadzi and Sheppard.[3] The spectrum

studied by Borisevich.[6] The present work was undertaken with a view to resolve some of the ambiguities found earlier in the parent molecule as well as to study the effect of OH substitution.

INFRARED SPECTRA OF QUINIZARIN

Experimental.—The substance in the crystalline powdered form was obtained from Eastman Kodak Company and purified by sublimation. The infrared spectrum was recorded with a Perkin Elmer 221 Spectrometer equipped with NaCl optics in the region 650–4000 cm.[-1] The spectrum was recorded for the substance in the form of powdered solid mixed with KBr pressed into pellets. The concentration of the compound was (1–1·5%) with KBr. The spectrum is reproduced in Fig. 1.

FIG. 1. Infrared spectrum of 1, 4-Dihydroxyanthraquinone.

of 1, 4-dihydroxyanthraquinone in infrared was examined by Urner Liddel[4] who found that the spectrum contained many unresolved bands. The infrared spectrum of 9, 10-anthraquinone has recently been studied in detail and approximately all the fundamentals and combinations have been assigned.[5] In the case of Quinizarin the assignments of various frequencies to the different modes of vibrations have been made with the help of those of the parent molecule. However among the sixty fundamentals expected only thirty-five have been assigned. The absorption and fluorescence spectra in the vapour and solutions in EtOH of 1, 4-dihydroxyanthraquinone was previously

Results and Discussion.—Assuming the molecule to be a planar one it may be assigned to the point group C_{2v}. Thus it will have 72 internal modes of vibration. Out of them 60 are active in the infrared and 12 belonging to a_2 species are inactive. In Table I the assignments of various frequencies met with to different modes of vibrations have been made and correlated to the frequencies of 9, 10-anthraqninone.

In solution the C–O stretching frequency was found to have a value 1627 cm.[-1] by Flett[2] for this molecule whereas a value of 1631 cm.[-1] has been assigned to this in the present work, showing thereby a hydrogen bonding in the solid

TABLE I
The fundamental vibrational frequencies of 1, 4-dihydroxyanthraquinone

Frequency cm.⁻¹	Intensity	Species	Type of vibration	Corresponding frequencies in anthraquinone cm.⁻¹
654	0·5	b_2	Skeletal deformation	660
682	0·5	a_1	Ring breathing	682
697	4	a_1	C—H bending	693
726	3·5	b_2	Skeletal deformation	718
755	1	b_1	C—H bending	765
793	10	b_2	O—H in-plane bending	..
853	0·5	b_2	O—H out-of-plane bending	..
943	1	b_1	C—H bending	940
951	2	b_2	Skeletal deformation	937
966	5	b_1	C—H bending	..
1026	4·5	a_1	do.	1035
1070	4	b_1	do.	1080
1148	6	a_1	O—H in-plane angle deformation	..
1149	5·5	a_1	C—H bending	1149
1161	1	b_1	do.	1168
1212	10	b_2	do.	1210
1227	13	a_1	O—H in-plane angle deformation	..
1257	14	a_1	C—C stretching	1282
1308	7	a_1	do.	..
1316	8·5	a_1	do.	..
1334	7	a_1	do	..
1360	7	b_1	do.	1371
1394	6·5	a_1	do.	1392
1412	0·5	a_1	do.	1412
1454	13	a_1	do.	1455
1476	1	a_1	do.	1469
1530	0·5	a_1	do.	1532
1592	13	a_1	do.	1595
1631	13	a_1	C=O stretching	1672
1670	0·5	a_1	C—C stretching	..
3075	2	b_2	C—H stretching	3035
3420	2	b_2	do.	..

phase as well. There is equally good agreement in the value of

C—O—H angle deformation

mode of vibration found as 1148 cm.⁻¹ in the present case and reported as 1150 cm.⁻¹ by Hadzi et al.[3] Likewise the OH out-of-plane bending vibration at 793 cm.⁻¹ and 853 cm.⁻¹ and OH in-plane bending at 1227 cm.⁻¹ have been observed and correlated with the frequencies 793, 863 and 1228 cm.⁻¹ assigned to these modes by them. The strong band at 1592 cm.⁻¹ is assigned to C–C stretching mode corresponding to 1592 cm.⁻¹ in anthraquinone.

EMISSION AND ABSORPTION SPECTRA OF QUINIZARIN

Experimental.—The discharge tube was an ordinary type of 20 cm. in length. Benzene was used in the process for exciting the emission and suppressing the CO band. The green yellow emission glow characteristic of the substance

was obtained with transformer discharge at 1000 volt p.d. with continued heating from beneath. The spectrum was recorded in the Fuess glass spectrograph using 1-F plate with an exposure of 4 hours. As regards the absorption spectrum it was obtained with a cell of 100 cm. length in the range of temperatures 130–170° C. obtained with the help of a calibrated furnace. It was however observed that the optimum temperature of the best development of band was at 145° C. An ordinary bulb of 6 volt was used as the continuous source. Using exposure time of two minutes the spectrum was recorded on the Kodak P-1200 plate.

Results and Discussion.—The emission spectrum of Quinizarin lies in the range 5000–6000 Å, and the corresponding absorption lines in the region 5000–4000 Å. These consist of a few broad and diffuse bands only. A system near about 4000–4500 Å was also observed in the process of emission but with extremely faint intensity and therefore it could not well be recorded. Assuming C_{2v} symmetry for the molecule both in the ground state as well as in the excited states the system has been analysed, taking the band at 19987 cm.⁻¹ as the origin. The absorption spectrum which lies in the range 4000–5000 Å shows a clear correspondence with the emission, with (0, 0) band occurring exactly at the same position. The analyses have been done in terms of the three fundamental ground state frequencies: 398 cm.⁻¹ (ring vibration), 840 cm.⁻¹ (C–H out-of-plane bending) and 1680 cm.⁻¹ (C=O stretching) the corresponding values of which in the excited state are 407 cm.⁻¹, 830 cm.⁻¹ and 1415 cm.⁻¹ It may be noted that these are the predominating modes of vibration met with in the parent molecule anthraquinone as well. The (0, 0) band of anthraquinone taken in the vapour phase was believed to be at 21950 cm.⁻¹.[1] Thus there is a shift in the present case towards lower frequency. This shift towards the lower frequency side is presumably due to the substitution of the O–H group in the anthraquinone. The effect of introducing a basic group such as OH into the ring is shown by Abrahamson,[7] with the result that as resonating with the π electron system the highest filled orbital of the ground state would go up and that of OH group lowered. However the non-bonding orbital containing the lone pair electrons will interact inductively with the OH group and therefore their energy level would be depressed. Therefore a shift towards higher frequency is to be expected on substitution

$(0,0)$ 19987 cm.$^{-1}$

Absorption

Emission

19987 cm.$^{-1}$ $(0, 0)$

FIG. 2.   Emission and absorption spectra of quinizarin.

TABLE II

Analysis of emission and absorption spectra of 1, 4-dihydroxyanthraquinone

Emission wavenumber cm.$^{-1}$	Intensity	Absorption wavenumber cm.$^{-1}$	Intensity	Separation from 0-0	Analysis
16685	ms	..	..	−3302	$0 - 2 \times 1680$
17109	s	..	..	−2878	$0 - 1680 - 840 - 398$
17422	vvs	..	..	−2565	$0 - 1680 - 840$
17859	s	..	..	−2128	$0 - 840 - 398$
18307	vs	..	..	−1680	$0 - 1680$
18768	s	..	..	−1219	$0 - 840 - 398$
19147	s	..	..	− 840	$0 - 840$
19389	ms	..	..	− 898	$0 - 398$
19987	w	19987	vs	0	$0 - 0$
..	..	20394	s	407	$0 + 407$
..	..	20010	s	830	$0 + 830$
..	..	21216	s	1229	$0 + 830 + 407$
..	..	21402	ms	1415	$0 + 1415$
..	..	21662	mw	1675	$0 + 2 \times 830$
..	..	22489	w	2502	$0 + 3 \times 830$
..	..	22659	w	2672	$0 + 1415 + 830 + 407$
..	..	22792	w	2805	$0 + 2 \times 1415$
..	..	23197	vw	3210	$0 + 2 \times 1415 + 407$

s = strong,   ms = medium strong,   vs = very strong,
vvs = very very strong,   w = weak,   mw = medium weak,
vw = very weak.

quencies due to substitution it has been observed that there is not much change in their values from the parent molecule. There is however a striking difference between the $C = O$ frequency reported in infrared as 1626 cm.$^{-1}$ and the value observed in the present work as 1680 cm.$^{-1}$ The sudden drop in infrared was due to the formation of hydrogen bonding.

In view of the correspondence between the emission and absorption and the fluorescence reported,[6] the transition involved in this process seems to be a singlet-singlet. The correspondence of absorption and emission spectrum of Quinizarin in the vapour state indicates that the emitter is Quinizarin itself rather than any other fragment of it. Shygorin et al.[8] concluded from coincidence of phosphorescence and luminescence spectra that either the low excited singlet level coincides with that of the triplet or it is the triplet level alone which effects the emission. Our observation also seems to be in agreement with this. Thus in the absence of other experimental supports, it will be difficult to assign a T–S electronic transition as for some other quinones,[9] except for the fact that it is an n-π type.

which, however, is not borne out by our present observation. As regards the change in fre-

ment of Spectroscopy, B.H.U. The authors are grateful to him for his interest in the work and to Dr. M. G. Jayswal and S. N. Singh for their co-operation in the work.

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CELL CULTURES DERIVED FROM LARVAE OF *AEDES ALBOPICTUS* (SKUSE) AND *AEDES AEGYPTI* (L.)

K. R. P. SINGH

Virus Research Centre,* Poona, India

GRACE[1] established a cell line from axenically grown larvæ of *Aedes ægypti* about to pupate by employing a culture medium containing hæmolymph of the moth, *Antheræa eucalypti*. However, his further efforts to establish more cell lines from *A. ægypti* were not successful. Kitamura[2] cultured ovarian tissue of three species of mosquitoes, *Culex molestus, Aedes albopictus* and *Aedes ægypti,* using a culture medium consisting of medium 199 and calf serum. He was able to subculture the cells of *Aedes* up to the eighth passage. Many other workers[3-8] have also attempted to culture and subculture mosquito cells without much success.

This communication reports the successful establishment of three cell lines of *A. albopictus* and two of *A. ægypti* using a culture medium without insect hæmolymph.

Tissues for cultures were obtained from freshly hatched larvæ of *Aedes albopictus* and *Aedes ægypti*. The eggs were surface sterilized by washing twice with acetone and then immersing for 15-20 minutes in White's solution.[9] Eggs thus sterilized were washed twice with sterile distilled water and allowed to hatch in Rinaldini's salt solution[10] (RSS) under reduced atmospheric pressure. Most of the eggs hatched within ten minutes. Several hundred freshly hatched larvæ were transferred to a small test-tube with 1 ml. of 0·25% trypsin, (1 : 250, Difco) in RSS. The larvæ were cut into small pieces with sharp fine-pointed scissors.

Five more ml. of 0·25% trypsin solution were added to the tissue suspension which was then transferred to a 15 ml. centrifuge tube and incubated at 37° C. for ten minutes. After incubation the tissues and cells were mixed with a Pasteur pipette for 2-3 minutes and centrifuged at 1,000 RPM. The sediment was washed once with RSS, suspended in 5 ml. of the culture medium and the entire volume transferred into a 3 oz. bottle. The cultures were incubated at 28° C.

Culture medium, used by Mitsuhashi and Maramorosch[10] for leaf hopper tissue culture, was used in the present study. This culture medium consisted of 20 mg. $NaH_2PO_4H_2O$; 10 mg. $MgCl_2.6H_2O$; 20 mg. KCl; 20 mg. $CaCl_2.2H_2O$; 700 mg. NaCl; 12 mg. $NaHCO_3$; 400 mg. d-glucose; 650 mg. lactalbumin hydrolysate; 500 mg. yeastolate; 20 ml. fetal bovine serum; 1·5 ml. of mixture of penicillin and streptomycin (to give 1,000 units of penicillin and 1·0 mg. streptomycin per ml.), and 78·5 ml. of glass distilled water. Fetal bovine serum and antibiotics were added after the rest of the medium was filtered through millipore filter (size 0·22 μ). The pH of the complete medium was 7·0.

Two days after the cultures of *A. albopictus* were set up, most of the cells were attached to the glass surface and were found multiplying. The number of cells continued to increase and a complete monolayer was formed by the end of two weeks. Two to three weeks after the cultures were set up the floating tissue fragments were removed and the first subculture of the attached cells was made. In the subsequent passages complete monolayers were formed within seven days and the subcultures were made every week. The subcultures of cells

were made as follows : The cells in the bottles for subculturing were washed twice with 2-5 ml. of $0 \cdot 1\%$ trypsin in RSS and incubated at 37° C. for 2-3 minutes. One ml. of RSS was added to the bottle and the cells were removed by gentle pipetting. The cells were suspended in 10·20 ml. of fresh medium mixed with 5–10 ml. of old medium and seeded into three to six 3 oz. bottles. The cells attached immediately and started to proliferate within 24 hours. Three cultures of cells of *A. albopictus* were set up at different times and all the three cultures have undergone several passages. First culture is in 15th passage, the second in 10th passage and the third in 8th passage.

Mainly three morphological types of cells were observed in the *A. albopictus* cultures. The predominant cell type was noted to be round and 6–20 μ in diameter and the next common type was spindle-shaped measuring 7–10 μ wide and 15–90 μ long. The third type of cells was binucleated, round and 37–53 μ in diameter (Figs. 1, 2). Their exact relationship, if any, to each other is not known.

FIGS. 1–6. Fig. 1. Cell sheet of *A. albopictus* culture, × 50. Fig. 2. Different types of cells of *A. albopictus* cultures. Phase contrast, × 350. Fig. 3. Cells showing mitosis in culture of *A. albopictus* Feulgen staining with light green counter-stain, × 1,150. Fig. 4. Hollow vesicles developing at each end of a piece of larval tissue. *A. ægypti*, × 50. Fig. 5. Cell sheet of *A. ægypti* cultures, × 100. Fig. 6. Cells showing mitosis in culture of *A. ægypti* Feulgen staining with light green counter-stain, × 1,200.

The same technique of tissue culture was used for the cultures of *A. œgypti* cells. The growth pattern of these cells was different from that of *A. albopictus*. Three days after the cultures were set up, small hollow vesicles developed at the cut ends of the tissue fragments and continued to increase in size and number (Fig. 4). These vesicles appeared to consist of monolayers of epithelium like cells. Very few cells were found attached to the glass surface and therefore very little growth on the glass wall of the containers was observed. Eight to ten days after the cultures were set up, the floating tissue fragments with hollow vesicles were removed and cut into small pieces and seeded into new bottles. Within two days a large proportion of the cell masses attached themselves to the glass wall but the floating tissue fragments again developed hollow vesicles. Over the next week the numbers of the cells sticking to the glass as well as those of the hollow vesicles increased. Two weeks after the seeding of the cultures the floating tissue fragments with hollow vesicles were removed and the first subculture of the attached cells was made. Subsequent cultures were made at intervals of one to two weeks depending upon the growth of the cells. The cells attached themselves to the glass immediately and were found proliferating within 24 hours.

Four such cultures of cells of *A. œgypti* larvæ were set up. One was lost due to contamination in the 11th passage and another in the 7th passage. Of the remaining, one is in the 15th passage and the other in the 4th passage. These cultures mainly consisted of an epithelial type of cells (Fig. 5) and even after many subcultures still have a tendency to form hollow vesicles and occasionally tube-like structures.

Many mitotic figures, some showing diploidy or polyploidy, were seen in cultures of both species (Figs. 3 and 6).

These established cell cultures of *A. albopictus* and *A. œgypti* can be maintained with 10% fetal bovine serum in the medium. The cultures are now being adapted to medium 199 and minimum essential medium (Eagle) with 10% fetal bovine serum. A few subcultures have been made withiut any apparent ill-effect on the cells. Further studies on the growth of these cell cultures in different media and their susceptibility to different viruses are in progress.

I thank Drs. T. Ramachandra Rao and C. R. Anderson for their advice. The technical assistance of Mr. U. K. Murty Bhat is acknowledged.

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MANGANESE IN BIOLOGICAL SAMPLES *

MISS C. B. SULOCHANA

University Botany Laboratory, Madras-5

DETERMINATION of manganese by conversion of Mn into MnO_4^- has been known since 1845.[1] Of the many oxidising agents tested for this reaction,[2-4] potassium periodate[5,6] and ammonium persulphate[7-9] are more commonly used with biological samples, however, with varying success. The sensitivity with potassium periodate is reported to be 2 to 7 μg. Mn/ml. and with ammonium persulphate 1 to 2 μg. Mn/ml. The reaction with potassium periodate in strongly acid solution is said to be autocatalytic

and more reliable; however, the reaction time is about 30 minutes and the colour is unstable for lower Mn levels. Reaction with ammonium persulphate is considered erratic,[5] and particularly unsuitable for soil samples,[10] but is recommended by others as satisfactory and more economical.[8,11] Discrepancies in values of Mn have been reported with all the oxidising agents tried hitherto on account of interfering substances such as chlorides, iron and titanium, as well as due to acidity, organic impurities, and lack of sufficient oxidiser for stabilising the reaction.[2] Preference for any oxidising agent seems to be based on the degree

of control of interfering factors as well as the ease with which the final reaction could be carried out. Obviously, more critical attention is indicated in the preparation of samples for the dependability and uniformity of the colorimetric reaction. The procedure tested in this laboratory and found to be critically reproducible with an improved sensitivity of $0.1 \mu g$. Mn/ml. for a wide range of biological samples is reported here.

Reagents.—Analytical grades of concentrated sulphuric acid, nitric acid, perchloric acid, orthophosphoric acid, 0.15% aqueous silver nitrate solution, and 20% aqueous ammonium persulphate solution.

Glass distilled water redistilled with potassium permanganate and a little potassium hydroxide was used throughout.

Standard Series.—50 mg. of electrolytically purified manganese metal was dissolved with minimum quantity of concentrated nitric acid. The flask was warmed carefully to expel the nitrous fumes completely, and the solution was made up to 50 ml. with redistilled water. Further, dilutions were made to give $100 \mu g$. Mn/ml. and $10 \mu g$. Mn/ml. respectively. Appropriate aliquots from the stock solutions were transferred to 100 ml. Pyrex conical flasks to give 5, 10, 20, 30, 40, 50, 60, 70, 80, and $100 \mu g$. Mn. To this were added 10 ml. of redistilled water, 5 ml. of 0.15% silver nitrate solution, 2 ml. of ortho-phosphoric acid and heated to boiling prior to addition of 1 ml. of *freshly prepared* ammonium persulphate solution. The colour reaction was instant. The contents were boiled for a minute and an excess of few drops of ammonium persulphate solution was added, cooled and made up to 50 ml. Using 10 mm. quartz cells, optical density readings were taken at $525 \, m\mu$ wavelength in UVISPEC spectrophotometer. Readings taken after 24 hours showed no variations. The relationship between Mn concentrations and the optical density readings was linear (Fig. 1). This was true for an extended range up to $10 \mu g$. Mn/ml.

Preparation of Biological Samples.—Half to one gram of samples (whole or powdered) were weighed into 100 ml. Pyrex conical flasks; 15 ml. of concentrated nitric acid were added and left overnight for cold digestion. If heated directly, there was a tendency for violent reaction with the contents boiling over resulting in loss of material. After the initial cold digestion, the flasks were placed on an aluminium plate over an electric hot plate. When the brown fumes subsided, 0.5 ml. of sulphuric acid

and 0.5 ml. of perchloric acid were added. It was a good precaution to add perchloric acid dropwise at short intervals. The digestion now proceeded at a rapid rate; if necessary more nitric acid was added. The contents became gradually pale yellow to colourless. The contents were evaporated to dryness, the residue dissolved in 10 ml. of redistilled water and evaporated to dryness. This was repeated once over. Finally the contents (pale yellow or colourless, and crystalline) were dissolved in 10 ml. of redistilled water while the flasks were still hot. To this were added silver nitrate solution and phosphoric acid, heated to boiling and the oxidation was effected with ammonium persulphate as for the standards. In 3 to 4 hours the samples were ready for optical density readings.

FIG. 1. Relationship between Mn concentrations and optical density readings at $525 \, m\mu$.

An acid blank was prepared alongside. No colour was obtained in the case of acidand water blanks. Routine recovery tests were also made for quantitative checks. The experimental error was less than 2%. The colour was stable at all concentrations of Mn and in the cases of a variety of samples tested. Wet digestion was preferred in order to avoid any possible loss of material in handling; further the entire procedure was carried out in the same container. Where samples were small, lesser quantities of acids were used for digestion and the final volume was made up to 5 to 10 ml.

Standards and digestates were also oxidised with potassium periodate for comparison. Closely comparable values were obtained when the volume of sulphuric acid was carefully limited with reference to the Mn concentrations. The time taken for colour

development, however, was considerable with potassium periodate.

Total and exchangeable Mn,[12,13] in a large number of samples of *Lathyrus* field soils were satisfactorily estimated by this wet-ashing procedure followed by oxidation with ammonium persulphate. In the case of soils, however, filtration during sample preparation was necessary.

This procedure was usefully employed for Mn estimations in various crop plants from lathyrism endemic areas in Central India, in tissues of experimental animals fed *Lathyrus* diet, and in sera, CSF fluids and fecal samples of lathyrism patients.

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INFLUENCE OF SIMAZINE ON CHLOROPLAST METABOLISM

R. P. SINGH
Punjab Agricultural University, Hissar

AND

S. H. WEST
University of Florida, U.S.A.

A CHLOROPLAST, the site of photosynthesis, acts as energy capturing, storing and transferring device in carbon assimilation. The photosynthetic pigment, the chlorophyll and carotenoids, are concentrated within the dense lamellæ of the grana containing chloroplasts and in the lamellar chloroplasts. In addition to these pigments it consists of protein and lipid layers. It has been reported that simazine [2-chloro-4, 6-bis (ethylamino)-s-triazine] a selective herbicide inhibits the photochemical activity of isolated chloroplasts.[4-6] Ashton et al.[2] reported the destruction of chloroplast structure as the result of atrazine treatment. As no result is available to indicate the changes in the concentration of chlorophyll and protein of the chloroplast the present investigation was undertaken to study the influence of simazine on the chlorophyll and protein metabolism in this very important organelle of the plant.

METHODS AND MATERIALS

In this investigation, seminole variety of oats (*Avena sativa* L.) which is susceptible to simazine was grown in the acid washed sand treated with 2 ppm of simazine with the use of Hoagland-Arnon complete nutrient solutio The plants were grown under controlled ten perature, photoperiod and light intensity for 1 days before their desiccation.

Determination of Chlorophyll.—Total chlor phyll, chlorophyll *a* and chlorophyll *b* simazine treated and control plants we determined by the method of Association Official Agricultural Chemists.[3] In all fou samples in three replications were collecte at two-day intervals starting six day after the treatment. The following equation were used to determine these chlorophyll

Total chlorophyll (mgm per litre) $= 7.12$ A $652 + 16.8$ A 634.5

Chlorophyll *a* (mgm per litre) $= 9.93$ A $652 - 0.777$ A 634.5

Chlorophyll *b* (mgm per litre) $= 17.6$ A $634.5 - 2.81$ A $652.$

where $A =$ Absorbance.

Estimation of Chloroplast Protein.—Triplicat samples of plants from simazine and contro treatments were collected at two-day interval starting six days after treatment. The tissue was homogenized in $0.5 M$ glucose, $0.02 M$

magnesium chloride and $0.02\,M$ phosphate buffer at pH 7·0. The homogenate was filtered through cheese cloth. The filtrate was centrifuged at $2,000 \times g$. for ten minutes to sediment chloroplasts. The protein in this fraction was precipitated by 5% cold TCA. The chlorophyll and lipids were removed by washing the protein pellet several times with undiluted acetone. The protein was dissolved in $0.01\,M$ NaOH and determined by the method of Lowry et al.[5]

vations of Schneider[7] demonstrate qualitative changes in the chlorophyll contents in simazine-treated plants. Ashton and Bisalputra[1] have also reported the reduction in the amount of *Chlorella* chlorophyll. The findings of this investigation clearly demonstrate the inhibition in chlorophyll *a* content in the earlier period of phytotoxicity.

Inhibition in the synthesis of chloroplast protein is obvious from the findings of this experiment. Therefore, on the basis of these

TABLE I

Changes in chlorophyll and chloroplast protein content of oat shoots caused by simazine treatments

Days after treatment	Simazine concentration (ppm)	Chlorophyll (mgm./gm. fr. wt.)		Chloroplast protein (mgm./gm. fr. wt.)
		Chlorophyll *a*	Chlorophyll *b*	
6	0	12·67	3·80	3·96
	2	7·81	2·33	2·85
3	0	1`·18	5·13	4·69
	2	7·01	2·52	2·47
10	0	1ᵤ·60	5·24	5·47
	2	6·32	2·55	2·19
12	0	13·43	6·62	4·88
	2	4·42	1·67	1·90

EXPERIMENTAL RESULTS

The concentration of chlorophyll *a* and *b* in the control plants increased upto eight days of the growth period, and decreased in later samples. Chlorophyll *b* increased in all the samples studied. On the other hand, the chlorophyll determinations in the simazine treated plants showed that chlorophyll *a* and chlorophyll *b* were drastically reduced as the age of plant advanced. In the last sample, the degree of reduction in chlorophyll *b* was more intense than in the chlorophyll *a* content.

The concentration of chloroplast protein increased in control plant samples collected upto 10 days after the treatment. The chloroplast protein content decreased as the period from simazine treatment progressed. The maximum reduction in protein content due to simazine treatment was observed in the later two samples.

DISCUSSION

A marked influence of simazine was observed on the chlorophyll contents of oat plants. These findings have revealed that in the earlier period of simazine toxicity chlorophyll *a* was reduced more than chlorophyll *b* but the results were reversed in the later samples. The obser-

results it may be postulated that simazine inhibits protein synthesis in the seat of synthesis —the chloroplast organelle. This may be the reason for the findings of Ashton et al.[2] that atrazine alters the chloroplast structure. The disintegration of chloroplast structure as the result of inhibition in protein synthesis from simazine toxicity may be the probable reason for reduction in the chlorophyll content.

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LETTERS TO THE EDITOR

TRANSMISSION OF ULTRASONIC WAVES THROUGH MICA

MICA, being a transparent crystalline solid obtainable in thin sheets, is quite suitable to be used as window to ultrasonic beam which is required to pass very often from one liquid to the other in many investigations. In fact Dutta[1] and Samal used mica window for trap vessels used in their thermal method adopted for the determination of ultrasonic absorption coefficient of. some organic liquids. But the transmission of ultrasonic waves through mica has not been studied so far except for the work of Boyle[2] and Sproule and Sanders[3] confined to thin sheets of homogeneous solids like steel, brass and nickel immersed in water. The present work is designed to study how mica transmits ultrasonic waves of different frequencies.

Thin sheets of mica of uniform thickness are prepared from thick crystals and fixed on brass frames with an adhesive. The thickness is accurately measured with the help of Michelson's interferometer and checked up by a screw gauge.

The ultrasonic waves are generated inside pure transparent kerosene contained in a long rectangular glass vessel with optically plane faces. The mica partitions are always placed inside kerosene at a distance of 5 cm. from the ultrasonic transducer which is an X-cut quartz of natural frequency 1 mc./s. The intensity of the ultrasonic beam is determined at a fixed distance of 10 cm. from the transducer with and without the mica partitions by the optical method adopted by Samal.[4] The transmission coefficient is calculated for different partitions with three frequencies of 1, 3 and 5 mc./s. of the ultrasonic beam.

It is clearly understood from the result that the transmission coefficient of mica decreases with the frequency of the beam. Figure 1 indicates that the variation of transmission coefficient with thickness is less gradual with higher frequency. It is quite interesting to note that a very thin sheet of mica of thickness less than 0·0025 cm. is perfectly transparent without showing any noticeable reflection of the beam which travels from kerosene to mica. Throughout the thickness of 0·0015 cm. to

TABLE I

Thickness in cm.	Tr. coeff. % 1 mc./s.	Tr. coeff. % 3 mc./s.	Tr. coeff. % 5 mc./s.
0·0015	100	100	100
0·002	100	100	100
0·0025	100	100	100
0·003	95·35	92·64	78·43
0·0038	86·38	78·77	68·9
0·04	84·25	75·30	59·02
0·0045	80·76	70·37	49·94
0·0058	76·37	(3·95	41·96
0·008	71·74	43·61	30·56
0·0095	63·46	35·06	22·65
0·014	61·90	24·98	15·63
0·0255	..	16·99	11·43
0·0355	35·38	14·81	10·23
0·046	34·53	10·81	9·49
0·056	32·92	7·25	8·52

FIG. 1

0·056 cm. the transmission coefficient does not show a tendency of rise which is expected according to the theory of Rayleigh[5] if the thickness is more than $\lambda/4$, λ being the wavelength of the ultrasonic beam in mica.

Physics Department,   N. C. GIRI.
Ravenshaw College,   K. SAMAL.
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CRYSTAL STRUCTURE OF BISTHIOUREA CADMIUM NITRATE

FROM X-ray diffraction data using Cu K_α radiation the crystal was found to have :

Cell dimensions : $a = 4 \cdot 09 \, Å$; $b = 12 \cdot 08 \, Å$; $c = 11 \cdot 45 \, Å$; $\beta = 102°$.

Density $= 2 \cdot 33 \, gm./c.c.$; Space group P $2_1/c$.

Number of molecules per unit cell : 2.

Cadmium occupies the special position at the centre of symmetry.

A (100) Patterson projection was made. As cadmium occupies the origin and its interactions with the other atoms must be the strongest, the Patterson was expected to resemble the structure in projection.

As cadmium contributes only to $k + l =$ even and not to $k + l =$ odd reflections, the calculations for scale factors to put the observed intensity (after applying the necessary physical correction factors) on absolute scale were made separately for the two sets of reflections.

From the atomic co-ordinates obtained from the Patterson the structure factors were calculated for $k + l =$ even using an isotropic temperature factor $B = 2 \cdot 0 \, Å^2$ for all the atoms, and the structure refined using only these reflections till the R-factor fell to 18% for $k + l =$ even.

With these atomic positions the structure amplitudes were calculated for $k + l =$ odd. The agreement was good.

As Cd is at the origin a generalised (100) Patterson with $1 \, k \, l$ data enabled the third co-ordinates of the other atoms to be found directly. In the refinement later of the co-ordinates the planar stereochemistry of the $-SC(NH_2)_2$ and $-NO_3$ groups was also used. The atomic co-ordinates are given in Table I.

TABLE I

Fractional atomic co-ordinates

Atom	x	y	z
Cd	·0000	·0000	·0000
S	·5061	− ·0332	·1624
C	·4604	·0595	·2631
N_1	·5434	·1645	·2663
N_2	·2702	·0275	·3519
$N_3(NO_3)$	·0498	·2582	·0294
O_1	− ·1021	·1816	·0717
O_2	·0161	·3511	·0421
O_3	·1930	·2158	− ·0472

The discrepancy factors are : $R_{okl} = 18 \cdot 5$, $R_{1kl} = 18 \cdot 0$. Further refinement with the entire three-dimensional diffraction data is being continued.

Department of Physics,   S. SWAMINATHAN.
Ind. Inst. Tech.,   S. NATARAJAN.
Madras-36 (India), *July* 25, 1967.

THERMAL EXPANSION OF POTASSIUM METAPERIODATE (KIO₄)

POTASSIUM metaperiodate crystallizes in the space-group $I4_1/a$ belonging to the tetragonal system and is isotypic with the Scheelite group, a family of ABO_4 compounds in which the BO_4 ions have distorted tetrahedral structures.[1] The nature and the amount of this distortion is likely to depend on the sizes of the A ions and can be expected to be reflected in the differences in the anisotropies of the physical properties of these crystals. The only substance of this group, for which data on the anisotropy of thermal expansion are available, is calcium tungstate.[2] A programme has therefore been drawn in this laboratory, to undertake a complete X-ray study of some of these crystals with a view to obtain detailed information on the temperature variation of the lattice parameters, the coefficients of thermal expansion and the position and thermal parameters of the atoms in the unit cell. The present note gives the results of the work done on the lattice thermal expansion of KIO_4, in the high temperature range.

Experimental techniques used in obtaining the X-ray diffraction photographs at different temperatures, their measurements and the evaluation of the precision values of the lattice parameters were essentially the same as described by Deshpande and Pawar.[3] Standard errors in the values of the parameters were calculated by the method of Jette and Foote.[4] The observed values of the lattice parameters along with the standard errors are given in Table I.

TABLE I

Values of the lattice parameters of KIO_4 at different temperatures

Temp. °C.	a in Å	c in Å
28·5	5·7311±0·0004	12·6045±0·002
40	5·7329±0·0004	12·6106±0·002
50	5·7360±0·0004	12·6218±0·002
60	5·7366±0·0004	12·6315±0·002
70	5·7407±0·0003	12·6466±0·002
80	5·7442±0·0004	12·6585±0·002

Refraction correction to the values of the lattice parameters were calculated and found to be smaller than the corresponding standard errors.

Least-squares fitting of the temperature-parameter data gave the following expressions for the temperature dependence of the axial lengths :

$$a_t = 5 \cdot 7297 - 14 \cdot 92 \times 10^{-6} \, t + 24 \cdot 29 \times 10^{-7} \, t^2.$$
$$c_t = 12 \cdot 5945 + 71 \cdot 60 \times 10^{-6} \, t + 92 \cdot 54 \times 10^{-7} \, t^2.$$

Here a_t and c_t are the values in Å units of the a- and c-parameters respectively at $t°$ C.

Values of the two principal coefficients of expansion, a_a and a at different temperatures were obtained from the temperature-parameter plots by the method given by Deshpande and Mudholkar,[5] and the following expressions were obtained for their temperature variation :

$$a_a = 5 \cdot 46 \times 10^{-6} + 61 \cdot 22 \times 10^{-8} t + 16 \cdot 92 \times 10^{-10} t^2.$$

$$a_c = 43 \cdot 73 \times 10^{-6} + 5 \cdot 24 \times 10^{-8} t + 125 \cdot 78 \times 10^{-10} t^2.$$

The mean coefficients of expansion over the range 28–80° C. were found to be $\bar{a}_a = 43 \cdot 96 \times 10^{-6}/°$ C and $\bar{a}_c = 82 \cdot 39 \times 10^{-6}/°$ C. The results are shown graphically in Fig. 1.

FIG. 1. Temperature variation of coefficients of thermal expansion of KIO_4.

A comparison of the present results on KIO_4 with Nassau and Broyer's results on $CaWO_4$ shows that both the crystals exhibit same type of anisotropy in thermal expansion. For both the compounds the room temperature value of thermal expansion along the tetragonal axis is very much larger than the corresponding value along the a-axis. Also, for both these crystals the value of a_c shows a stronger temperature dependence than that shown by a_a. These features can easily be understood in terms of the structures of these crystals. X-ray studies have shown that these crystals have some kind of a complex layer structure, the layers being perpendicular to the c-axis.[6-9] Each layer has

a two-dimensional CsCl-type structure of A and BO_4^- ions. Each A^+ or BO_4^- ion is surrounded by eight ions of the other sign, four at the corners of a square lying in the layers and the other four at the corners of a tetrahedron. The ionic interactions between any ion and the four ions of opposite sign lying in the same layer give rise to binding forces essentially along the layers and the interaction between this ion and the four ions of opposite sign situated at the corners of a tetrahedron provide binding forces with components along the layers as well as in perpendicular directions. Similar arguments are also valid for the interaction between ions at larger distances. Hence, the layers are very firmly bound and the binding between layers is relatively weak. This is the reason why the expansion along the tetragonal axis is found to be much larger than that observed along the layers.

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Physics Department,   V. T. DESHPANDE.
Univ. College of Science, RAMRAO PAWAR.
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VARIATION OF ULTRASONIC VELOCITY WITH TEMPERATURE IN ORGANIC MELTS

VARIATION of ultrasonic velocity with temperature in the following nine substances—carbazole, chloroacetic acid, adepic acid, chloral hydrate, resorcinol, anthracene, *ortho*, *meta* and *para-* nitroanilines, have been studied in the molten state over the possible temperature range. The phase path pulse interferometer[1] with suitable alterations for high temperature study is employed for the velocity measurement. The temperature of the liquid is maintained constant to ± 3 m./sec. at a frequency of 3 Mc./sec.

TABLE I

Sl. No.	Name of the substance		Molecular weight	Temperature range of study °C.	Ultrasonic velocity at lowest temp. V m/s.	$\dfrac{dV}{dt}$	Average molar sound velocity (R)	$M^{1/2}$ (dV/dt)
1.	Carbozole	..	167·2	250–290	1048	2·8	1694	36·2
2.	Chloroacetic acid	..	94·5	60–100	1024	3·0	653	29·2
3.	Adepic acid	..	145·1	160–210	1032	4·0	1324	48·2
4.	Chloral hydrate	..	165·4	55– 75	1227	4·0	1044	51·5
5.	Resorcinol	..	110·1	110–230	1520	2·9	1195	30·4
6.	Anthracene	..	178·2	280–340	952	2·6	..	34·7
7.	*o*-Nitroaniline	..	138·1	150–230	1290	2·64	1128	31·0
8.	*m*-Nitroaniline	..	138·1	150–230	1346	3·25	1285	38·2
9.	*p*-Nitroaniline	..	138·1	150–230	1384	2·7	1278	31·7

stant to ± 1° C. and the velocity is measured to an accuracy of ± 3 m./sec. at a frequency of 3 Mc./sec.

The results are presented in Table I. The value of the velocity corresponds to the lowest temperature of the temperature range studied. The ultrasonic velocity in all the melts studied showed a linear decrease with increase of temperature as observed by Schaaffs.[2] The values of the rate of decrease of ultrasonic velocity with increase of temperature '*dV/dt*' are also given in the table. It is found that there is a gradual decrease of velocity from *para* to *ortho*-nitroaniline, a behaviour which is observed in several other isomers. The adiabatic compressibility exhibited an increase with temperature, and the molar sound velocity[3] $R[= (M/\rho) V^{1/3}]$ for each substance was found to be fairly constant over the temperature range studied. The validity of the empirical relation put forward by Lagemann[4] $M^{1/2}(dV/dt) = 39$ is also checked in the present investigation.

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Physics Department,   T. KRISHNA MURTY.
Andhra University   K. SUBBA RAO.
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THERMOGRAVIMETRIC ANALYSIS (TGA) OF THALLOUS THIOCARBONATE

IN an earlier communication[1] evaluation of potassium thiocarbonate (PTC), a new substitute[2] for gaseous hydrogen sulphide, by precipitation of the thiocarbonate ($CS_3{}^{2-}$) sulphur as thallous thiocarbonate (Tl_2CS_3) had

been described. Thallous thiocarbonate is characteristically vermilion red and being quite stable has been thus employed as gravimetric precipitate for the evaluation of thiocarbonate sulphur as well as thallium(I). The present studies on thermogravimetric analysis of a sample of Tl_2CS_3 have been carried out with a view to ascertain its purity or stoichiometry and to study the mode of its transformation to various products resulting from rise in temperature.

To an aqueous solution of thallous nitrate, containing nearly 1 gm. Tl per ml, was added a standardised[3] 0·1 M PTC solution dropwise with constant stirring till the precipitation was complete and the supernatant liquid was yellowish due to the slight excess of the reagent added. The precipitate was collected by filtration through Whatman filter-paper No. 40. The precipitate was first washed with water till the filtrate was neutral and free from nitrate ions and finally with 80% alcohol. The precipitate was dried for about 24 hours by keeping it in a vacuum desiccator at room temperature.

The thermogravimetric data was collected using a Stanton's Thermorecording Balance model TR-I, installed at the Central Road Research Institute, New Delhi.

A weighed sample of dried thallous thiocarbonate Tl_2CS_3 (1000 mg.) was transferred to a crucible freshly tarred to 1000° and subsequently stored in a desiccator. The sample was subjected to a heating rate of 4 ± 0·2° per minute in an atmosphere of air. The data was collected for a range of temperature up to 1000°. The period of maximum rise in temperature was about 4 hours. The sensitivity of the balance per small chart division having been 1 mg. and chart range 100 mg. All data used in the preparation of the thermogram was corrected for buoyancy (experimentally determined for the crucible used). The thermogram

shown in Fig. 1 was obtained by plotting different points of the original graph on X_ and Y-axes. All other instructions for operating the Stanton's Thermo-Balance given in the brochure supplied with the instrument were strictly followed.

Thermogravimetric Behaviour of Tl_2CS_3.— Thallous thiocarbonate was found to be thermally stable up to 130°, as seen from the thermogram (Fig. 1). Between 130° and 180°, the product apparently lost carbon disulphide

FIG. 1. Thermal decomposition of Thallium (1) thiocarboaate (Tl_2CS_3).

yielding sulphide of thallium which simultaneously got partially oxidised. A visible minimum at 180° was obtained because of the mixed product affecting the normal course of the curve. Over the broad temperature range of 180° to 680°, there was a continuous increase in weight showing progressive oxidation of thallous sulphide to thallous sulphate. The horizontal level between 680° and 760° corresponded to the expected weight of Tl_2SO_4. Beyond 760°, there was a continuous loss in weight due to the decomposition of the sulphate into oxide. Further loss in weight resulted from the eventual sublimation of the oxide. Similar loss has been reported by Duval[4] as well in connection with the thermolysis of pure thallous sulphate.

The thermal behaviour of thallous thiocarbonate as studied, has established its stoichiometry warranting the gravimetric procedure of its estimation. Also, a temperature range of 100° to 120° is found suitable for drying the product without allowing any decomposition.

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Department of Chemistry,   N. K. KAUSHIK.
University of Delhi,   KIRPAL SINGH.
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INFLUENCE OF ACETIC ACID ON THE DUAL ACTIVITY OF CHROMIA

PREVIOUS workers[1-4] have suggested that the type and degree of activity of a dual function catalyst may be at least partly due to the substrate-catalyst interaction and not entirely due to its intrinsic activity. Confirmation of this suggestion was sought by investigating the dehydration and dehydrogenation of isopropanol and cyclohexanol over chromia. The extent of the two types of reactions has been studied with the reactants taken alone as well as mixed with acetic acid, using a flow type of reaction unit as described by Pandao *et al.*[1] Acetic acid itself is known to react in oxide surfaces forming acetone.[5] For comparison of results, the extent of reaction for the different reactants was studied at various partial pressures using nitrogen as a diluent. Since the results were the same whether nitrogen or helium was used as a diluent, nitrogen can be assumed to be inert. The temperature employed was 460° C. and the contact time 0·67 seconds. The products were analysed using a gas chromatograph and an Orsat apparatus.

Acetic acid decomposes on chromia at 460° C. giving acetone water and carbon dioxide. Partial pressure studies showed that the conversion increased with increasing partial pressure of acid.

Both isopropanol and cyclohexanol underwent dehydration as well as dehydrogenation. In the case of isopropanol, the selectivity, *i.e.*, the ratio of dehydration to dehydrogenation, was 0·28 while for cyclohexanol the selectivity was 1·4. For both the reactants, the selectivity was independent of the partial pressure when nitrogen was used as the diluent, even though the overall conversion was a function of the partial pressure.

When mixtures of acetic acid and cyclohexanol were used, the ketonisation of the acid fell rapidly with increasing partial pressure of the alcohol, while the dehydration and dehydro-

genation steadily increased. The deydrogenation of the alcohol dominates over that of dehydration upto a partial pressure of alcohol of 0·4 atm ; while the ketonisation falls to a minimum. In this region the selectivity changes from the original value of 1·4 to 0·84. Beyond this partial pressure, dehydrogenation attained a steady value which was however, less than that in the presence of nitrogen as a diluent. Complete analysis of the products revealed the absence of any cyclohexyl acetate.

Mixtures of isopropanol and acetic acid yielded similar results except that dehydration was suppressed to a greater extent than dehydrogenation.

These results can be explained on the assumption that acetic acid besides poisoning a part of the dehydrogenation or dehydration area, depending on whether cyclohexanol or isopropanol is the reactant, quasi-permanently, competes with the alcohol for the remaining area. This results in the gradual increase in reaction with increase in partial pressure to attain rather low steady values. According to Wolkenstein's model,[6] acetic acid competitively adsorbed on the dehydration area can induce additional dehydrogenation activity in the catalyst causing the change in selectivity at low partial pressures of alcohol.

The results show that the substrate determines the type of interaction with the catalyst and hence plays an important role in determining the activity of the catalyst.

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SEPARATION AND DETERMINATION OF PALLADIUM AND NICKEL

THE well-known organic reagents used for the separation and determination of palladium and nickel contain the 'oxime' grouping. Dalzin[1] has been employed as a reagent for this purpose. Nioxime[2] and α-furildioxime[3,4] suffer from certain limitations. An empirical factor is required for the precipitation of nickel in

the case of the former, whereas nickel cannot be estimated due to the simultaneous occurrence of two complexes in the case of the latter. 2-Hydroxy-5-methyl-propiophenone–oxime[5] has already been proposed for such a purpose from these laboratories.

O-Vanillinoxime has been used as a reagent for the gravimetric determination of palladium,[6] nickel[7] and copper.[7] The quantitative ranges of pH for the precipitation of nickel and palladium are 5·0–10·0 in the case of former and 1·0–4·0 in the case of the latter. The difference in the ranges of pH of precipitation of the two metal ions has been made the basis of the present report.

Solutions of palladium chloride (Arora Matthey, India) and nickel sulphate (AnalaR, BDH) were prepared and standardized using dimethyl glyoxime. 1·0% (*w/v*) solution of the reagent (O-Vanillinoxime) was prepared in 95% alcohol and used in the subsequent studies.

The solution containing the two metal ions in question is taken and its pH adjusted using very dilute solutions of hydrochloric acid and sodium hydroxide to pH 2·0 in a total volume of 150 ml. A required amount of 1·0% alcoholic reagent (OVO) is added to the solution with constant stirring and digested on a steam-bath for about 30 mts. A yellow-coloured complex is obtained. Completeness of the precipitation is checked by D.M.G. paper. It is then filtered hot through a sintered glass crucible (G. 4) and washed with hot water, followed by 20% ethanol. The precipitate is dried between 120–130° C. in an oven to a constant weight. The conversion factor for palladium is 0·2425, the ratio of palladium to reagent in the complex being 1 : 2.

The filtrate is concentrated to a volume of about 100 ml. and precipitated reagent filtered off. Ammonium chloride is added to the solution and the pH adjusted to 7·0 with ammonium hydroxide and hydrochloric acid (or acetic acid) in a total volume of 150 ml. The precipitation is carried out from hot solution (70–80° C.), as described earlier for palladium. The green-coloured complex is dried between 110–120° C. in an oven till a constant weight is attained. The conversion factor for nickel is 0·15015, the ratio of metal to ligand in the complex being 1 : 2.

Results of the separation and gravimetric determination of the two metal ions are incorporated in Table I.

TABLE I

Wt. of Pd (II) taken (mg.)	Wt. of Ni (II) taken (mg.)	Wt. of Pd (II) complex (mg.)	Wt. of Pd (II) found (mg.)	Error for Pd (II) (mg.)	Wt. of Ni (II) complex (mg.)	Wt. of Ni (II) found (mg.)	Error for Ni (II) (mg.)
6·01	32·35	24·75	6·00	−0·01	215·5	32·37	0·02
12·01	25·88	49·54	12·01	0·00	172·50	25·90	0·02
18·02	19·41	74·32	18·02	0·00	129·45	19·44	0·03
24·02	12·94	99·38	24·09	0·07	86·25	12·95	0·01
30·03	6·47	124·00	30·07	0·04	43·05	6·47	0·00

Department of Chemistry,   D. P. Goel.
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A NOTE ON THE FEEDING MECHANISM OF TWO FLEAS

Deoras and Joshee[3] had mentioned that while feeding inside the ear of a mouse the proboscis of *X. cheopis* was bent at 90° and that the mechanism was probably the "capillary method". They had used a modified apparatus of the type used by Griffith and Gordon[4] and the findings were in keeping with those of Lavoipierre *et al.* and Hamachi.[5]

X. cheopis is said to be a better transmitter of plague than *X. astia* (Bacot and Martin[1]). A simple apparatus has been designed by which the feeding mechanism of both *X. cheopis* and *X. astia* be observed. Deoras and Joshee[2] had showed differences in the number of proventricular teeth in the two sexes of *X. cheopis* and *X. astia*. Whether these differences have any effect on the feeding mechanism in the two sexes has to be verified.

The simple device for the present studies consists of two slides stuck at one end by an adhesive tape. A small thin chamber is formed by sticking coverslip pieces in the middle of one slide, leaving one side open. The shaven ear of a mouse immobilised by an injection of 0·2 to 0·4 c.c. of 2% solution of Nimbutal (pentobarbital sodium) is inserted in this chamber after putting one slide over the other. The slide along with the mouse with ear in the chamber is put on the stage of a microscope for observations, after a flea has been introduced into the chamber. A drop of boiling water is used to kill the flea in the act of feeding. The ear is then cut and a permanent mount made of the ear with the flea head and proboscis in various positions of feeding.

The observations done with the above apparatus have shown that the proboscis not only bends but even twists. An actual photograph, represented in Fig. 1, shows the extreme

FIG. 1. Whole mount section of a mouse ear with the flea proboscis. A—The screw type bending of the proboscis inside the mouse ear tissue.

case of bending of the proboscis. The studies have further shown that the laciniæ act as cutting blades and anchors. The Epipharynx acts as a sensory organ and the muscle fibre enables the laciniæ to bend even side-ways. Both the fleas adapt to pool as well as capillary feeding, but preferring the latter. The differences in the feeding mechanism between the two kinds of fleas are that *X. cheopis* first moves round the area, makes a selective couple of punctures before settling down to feed, while *X. astia* settles down immediately to feed as soon as it touches the skin of the mouse. There is no apparent difference between the feeding of male and female except that the latter could be starved for longer periods and take a longer time to feed than the former.

G. C. Chaturvedi for the help rendered from time to time.

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ON THE POLYSACCHARIDE CONTENT OF EARTHWORM CASTS

EARTHWORM casts (excretions) have more of plant nutrients, and soil particles in them are more aggregated in comparison to the corresponding cast-free soil.[1-5] However, there is considerable evidence that soil polysaccharides, claimed to be mostly of microbial origin,[6-10] play a key role in soil aggregation. But no attempt seems to have been made to characterise the chemical nature of the organic constituents which could possibly be responsible for increased stability of soil aggregates in the worm-casts.

Large earthworm casts (almost spherical, 2 to 4·5 cm. diameter) appeared on the soil surface in abundance in plots of Punjab Agricultural University Farm growing maize and bajra, in the month of September. The casts were collected from four fields together with the

corresponding soils. The casts were identified invariably to be excretions of *Euthyphœus waltoni.*

Air-dried earthworm casts were ground to pass 1 mm. sieve. 5 gm. of the samples were taken in 250 ml. Erlenmeyer flasks with 50 ml. distilled water and refluxed on steam-bath for 24 hours. Dry aqueous extracts, cast-free soil and earthworm cast samples were then hydrolysed with 6 N HCl (1 gm./10 ml.) for 24 hours (a preliminary trial had shown that for maximum liberation of soil polysaccharides a hydrolysis period of 24 hours was sufficient) by the procedure described by Singh and Bhandari (1963) and polysaccharide content (as apparent glucose) was estimated by Dubois *et al.* (1956) method. Nitrogen and organic carbon were estimated using the procedures described by Bremner (1960) and Mebius (1960), respectively, and pH by glass-electrode (soil-water suspension, 1 : 2·5).

It can be seen (Table I) that the worm-casts have considerably more of organic carbon and nitrogen than the parent soils. Except in one case, pH of all casts samples is lower than the cast-free soils.

The results further indicate (Table II) that on an average 4·5% of the organic carbon in the worm-casts has accounted for as polysaccharide fraction extractable with hot water, whereas in the case of aqueous extracts of soils no such quantitative characterization was possible.

TABLE I

Chemical analysis of soil and earthworm casts (Expressed as percentage on oven-dry basis)

	Soil					Earthworm casts				
	1	2	3	4	Avg.	1	2	3	4	Avg.
pH	7·9	8·2	8·3	8·1	8·1	7·7	8·1	8·4	8·0	8·0
Organic carbon	0·51	0·53	0·49	0·50	0·51	0·69	0·74	0·72	0·84	0·75
Nitrogen	0·068	0·069	0·064	0·061	0·065	0·075	0·078	0·079	0·082	0·078
C/N	7·5	7·7	8·2	8·2	7·7	9·16	9·5	9·1	10·2	9·5

TABLE II

Distribution of polysaccharides in soils and earthworm casts
(Percentage of total organic carbon)

	Soil					Earthworm casts				
	1	2	3	4	Avg.	1	2	3	4	Avg.
In aqueous trace extracts	Trace	Trace	..	Trace	..	4·92	3·47	5·81	4·17	4·5
In acid extracts	6·89	9·27	8·21	6·9	7·81	31·72	34·89	39·53	40·27	36·6

Acid hydrolysis of the soils and the casts has brought into solution as much as 7·81 and 36·6%, respectively, of the organic carbon as polysaccharides. In view of this evidence it may reasonably be stated that earthworm casts contribute significantly towards the polysaccharide content of soils and, therefore, play an equally important role in creation of water stable aggregates, like bacterial and fungal polysaccharides.

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ZIRCONS FROM THE QUARTZITES OF DODGUNI AREA, TUMKUR DISTRICT, MYSORE

The Dodguni area forms the southern part of the Chitaldrug schist belt of Dharwars. The rock types are quartzites, ferruginous quartzites, limestones, phyllites and schists. The general trend of the rocks varies from NNW-SSE to N-S. The main structure of the area is a northerly plunging anticline, the dip of the limbs varying from 50 to 80 degrees.

The quartzites occur as narrow elongated bands, the width generally not exceeding fifteen metres. Their colour is usually white, but sometimes it is grey or brown. Pichamuthu (1937) reported for the first time the occurrence of current bedding and ripple marks from the quartzites of this area.

The heavy minerals were separated from nineteen samples of quartzites taken from different parts of the area. Zircon, tourmaline, biotite, ilmenite, and magnetite are present, but zircon is most abundant. Prolonged reworking has resulted in the destruction of the less stable non-opaque minerals, leaving only the stable mineral zircon.[1] Zircons constitute more than fifty per cent. of the heavy residue.

The zircons are usually hyacinth red in colour. Brown, colourless, turbid and black varieties are also noticed. The majority of zircons are well rounded. Less rounded zircons preserve the original faces. Zircons with rounded outgrowths on rounded zircons are often noticed.

The length and breadth of about 250 grains of zircons from each specimen were measured. The following curves were constructed for each sample : (1) frequency-elongation ratio, (2) frequency-length, (3) frequency-breadth, (4) frequency-size and (5) cumulative frequency diagram for size.

Out of the nineteen samples, sixteen show an average maximum of elongation ratio at 1·4, the variation being from 1·3 to 1·5. The three other samples which are from the eastern part of the area have maxima at 1·5, 1·85, and 2·1, the frequency at maxima for these being very low as compared to the rest of the sixteen samples. In the frequency-length curves the average of the maxima are at 0·07 mm. and 0·1 mm. The frequency-breadth curve shows an average maximum of 0·09 mm. A cumulative frequency diagram was drawn to calculate the parameters of the size—quartiles, percentiles, and median, from which values of coefficient of sorting, skewness, and kurtosis were determined[3,4] (*see* Table I).

TABLE I

Size distribution of zircons

		Mean mm.	Mode mm.	Median mm.	Sorting coefficient Q_3/Q_1	Skewness $\dfrac{Q_3 Q_1}{M^2}$	Kurtosis $\dfrac{Q_3 - Q_1}{2 (P_{90} - P_{10})}$
Average	..	·088	·091	·092	1·169	1·00	·27
Range	..	·049–·112	·072–·118	·08 – ·114	1·06 –1·32	·88–1·18	·22–·28

Discussion.—The elongation, length, and breadth of zircons show no significant variation in the quartzites occurring in different places. The tendency of elongation ratio which is nearly 1·0 shows that the sediments were fine-grained.[6] The curves of frequency-elongation and frequency-length give well-defined maxima which indicates that the sorting of the zircons during deposition was very well done.[6]

The frequency-size curve shows the unimodality in the size distribution of the zircons. The curve is of leptokurtic type.

The value of coefficient of sorting also indicates the well-sorted nature of zircons. Size distribution of the zircons is essentially unskewed, the average skewness value being unity. The distribution of zircons in the quartzite is normal, since the size frequency curve is symmetrical, and the value of mean, median and mode are almost the same.[2] The essentially unskewed nature of the zircons shows that the behaviour of the depositional agent was normal with respect to time and velocity of deposition. There was enough time for the sorting of the material to a fine grade. The presence of some unusually large grains of zircons (less than 5%) shows that there was wide range of zircons at the time of deposition. This wide range in size has considerably been reduced by continued reworking brought about by depositional agents which were free from any sort of tectonic disturbance. These sediments are the results of prolonged and deep weathering, sorting, and abrasion, and are the products of the offshore sorting process of sedimentation.[1] The well-sorted nature of the sediments indicates that they are of the wave-moved type. The sediments were exposed to the wave base for repeated shifting, reworking, and sorting of the material. The excellent sorting, rounding, and abundance of stable heavy minerals, and also the high content of quartz, indicate that the rock is an orthoquartzite.

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OBSERVATIONS ON THE DEVELOPMENTAL PHYSIOLOGY OF THE MIRACIDIUM OF THE STRIGEID TREMATODE, *PROALARIOIDES TROPIDONOTIS* (VIDYARTHI, 1937)

Among trematodes embryogenesis either commences immediately so that at the time the egg is leaving the uterus a well-developed miracidium is ready to hatch (Genera *Philophthalmus* Looss, 1899 and *Singhiatrema* Simha, 1954) or the egg leaves the uterus in an unembryonated condition (fasciolids, echinostomes, strigeids, etc.). In *Proalarioides tropidonotis,* from the intestine of the water snake *Tropidonotus piscator* (Wall) the eggs at the time of liberation contain well-developed miracidia in striking contrast to the generally unembryonated condition obtained in other strigeids. The uterine eggs therefore afforded excellent opportunities to follow some interesting features pertaining to the imbibition of nutritive material by the developing embryo.

A remarkable feature is the way in which the miracidium orients itself to the vitelline material in the egg. At the end of development the miracidium is much longer than the egg and therefore lies curled and pushed toward one side. Two conspicuous sacs (S_1, S_2) lie frequently ventrally. These sacs appear to send dorsal extensions in the form of girdles (G_1, G_2) which are in close contact with the larva in the gaps between the first and second and second and third tiers of epidermal cells respectively (Figs. 1 and 2). In the early phases of development the embryo is enveloped by the closely packed vitelline cells. These cells with compact nuclei are loaded with glycogen as revealed by a positive PAS reaction which is abolished after saliva digestion (in sections). The vitelline cells in the fully formed uterine eggs also contain lipoidal material appearing positive to Sudan Black B. As development proceeds a gradual reduction in the vitelline material could be noted. At a time when ciliated epidermal cells appear the vitelline material is no more than a few irregular masses (VM) continued into

the characteristic dorsal girdles. When full growth is attained only two large sacs connected to the girdles are seen (Fig. 2). Shortly

FIG. 1. Diagram of miracidium in egg when ciliated epidermal cells appear. Irregular masses of vitelline material (VM) and the formation of girdles G_1, G_2 are shown

FIG. 2. Photomicrograph of fully developed miracidium in egg showing the characteristic fluid filled sacs (S_1, S_2) and the girdles (G_1, G_2).

before hatching the miracidium characteristically becomes free of attachment and the sacs mentioned above are pinched off as closed vesicles. The larva now moves vigorously inside the egg, the two fluid filled sacs containing some fatty spherules are tossed up and

down. Finally the miracidium hatches. The behaviour of vitelline cells and the formation of girdles would appear to constitute a device by which nutrition is conveyed to the growing embryo. It is also clear that the fluid filled sacs are at the end discarded. It seems reasonable to state that the sacs serve to retain metabolic end products the egg being of cleidoic type. In this connection it is worth recalling the observations of Onorato and Stunkard[1] on the developing eggs of the blood fluke *Spirorchis*. These authors have described the appearance of numerous gas vacuoles in the egg and remarked that probably the gas is carbon dioxide, a product of metabolism of the larva. However, since the vitelline cells contain apart from their nuclei which disintegrate, glycogen and some lipoidal material in the cytoplasm the degradation of all these classes of substances occurs. The waste metabolic end products that accumulate may therefore be of more complicated nature.

In continuing the argument about the nutritive role of the mechanism described above some facts concerning certain miracidia may now be mentioned. During or after invasion of the molluscan host by the miracidium, the ciliated epidermal cells are cast off. The released sporocyst after reaching the site of further development, grows deriving nutrition that must be absorbed through its wall because it has no mouth and gut. Bryant and Williams[2] have indicated that alkaline phosphatase occurs in the sporocyst wall. The central role of alkaline phosphatase in the uptake of nutrients is well known. In the developing miracidium inside the egg when ciliated epidermal cells appear, the sporocyst wall lies exposed only in the inter-tier regions. In the present study the fact that the vitelline cells contain glycogen is indicative of an intense carbohydrate metabolism in the embryo. Thus the significance of the occurrence of girdles just at the inter-tier regions as observed in the miracidium of *P. tropidonotis* becomes clear. The vitelline cells being extra-embryonic a mechanism is built up whereby contact between these cells and the sporocyst wall of the growing embryo is established. In this context the sporocyst is comparable to the cestodes and acanthocephala which are gutless and in which alkaline phosphatase in the cuticle is important in the absorption of nutritive substances.[3-5] It is of interest to mention here the work of Cheng[6] which points to the fact that the sporocyst of *Glyphthelmins pennsylvaniensis*

Cheng in the hepatopancreas of *Helisoma trivolvis* (Say) absorbs monosaccharides resulting from the breakdown of glycogen in the intact cells.

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Department of Zoology,   J. S. BHARATHI.
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A NOTE ON THE OCCURRENCE OF CYCADEAN FRONDS IN THE HIMMATNAGAR SANDSTONE

THE present communication records the occurrence of Cycadean fronds in the Himmatnagar Sandstone.[1] The fossils were collected by the author, during the course of ground-water investigation in the Field season 1965-66, from the ferruginous sandstones belonging to the Himmatnagar Sandstone formation, very near the contact of the latter with the Idar granite, about 3·2 km. N. 17° E. of Himmatnagar (23° 36′ 00″ : 72° 57′ 45″ ; 46 A/14) in Sabarkantha District, Gujarat State. The fossiliferous ferruginous sandstones, which are coarse grained and quartzitic, represent the lowest section of the Himmatnagar Sandstone Series. The cycadean leaf type resembles, in shape of the pinnæ and their attachment to the upper surface of the rachis, with *Dictyozamites* (Fig. 1) but in the absence of well

FIGS. 1-3. Fig. 1. Cycadean frond. Fig. 2. *Matonidium indicum*—Stem. Fig. 3. *Matonidium indicum*

preserved characteristic anastomosing veins it is difficult to assign the fronds with certainty to the latter genus. The cycadean fronds were found to be associated with the stems and leaves of *Matonidium indicum* (Figs. 2 and 3) Sahni.[2]

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THE ANTIBACTERIAL PROPERTIES OF MARINE BLUE-GREEN ALGA *TRICHODESMIUM ERYTHRAEUM* (EHR.)

IT has been shown in recent years that some of the phytoplanktonic organisms exhibit antibacterial activity.[1-6] The present note records observations on the antibacterial activity exhibited by the marine blue-green alga, *Trichodesmium erythrœum* (Ehr.).

The investigation was carried out adopting the method suggested by Gupta *et al.* (*loc. cit.*). The algal material was thoroughly washed in sterilised glass distilled water and 0·3 ml. of the packed cell volume of the alga from a fresh subculture was then crushed with 0·5 ml. of the sterilised glass distilled water. A pinkish-gray viscous fluid was thereby obtained. Small filter-paper discs (2·3 mm. in diameter) cut

also run concurrently, using sterilised glass distilled water. The petri-dishes including controls were then incubated at 37° C. for 24 hour and the diameters of the zones of inhibition of bacteria were measured.

The extent of the inhibition of the growth of the different species of bacteria used in the experiment is shown in Figs. 1-6 and Table I.

FIGS. 1-6. Showing zones of growth inhibition caused by algal extract. Fig. 1. *Staphylococcus aureus*. Fig. 2. *Sarcina leutia*. Fig. 3. *Bacillus subtilis*. Fig. 4. *Escherichia coli*. Fig. 5. *Pseudomonas* sp. Fig. 6. *Xanthomonas* sp. C. Control.

It will be seen from Table I that *Trichodesmium erythrœum* shows antibacterial properties, effective against both gram-positive and gram-negative bacteria (Figs. 1 to 6). The inhibitory effect is greater on *B. subtilis*,

TABLE I

Showing diameter in mm. of zones of inhibition formed by the action of algal antibiotics

Name of alga		Test organisms					
		Gram positive			Gram negative		
		S. aureus	*S. leutia*	*B. subtilis*	*E. coli*	*Pseudomonas*	*Xanthomonas*
T. erythrœum	..	20·0 (19–21)	16·5 (16–17)	21·0 (20–22)	19·5 (19–20)	19·5 (19–20)	17·0 (16–18)
Control	..	Nil	Nil	Nil	Nil	Nil	Nil

from Whatman filter-paper No. 1, were soaked in this fluid. The paper discs containing the algal extract were then transferred to the surface of the peptone agar plates which had been inoculated separately with six species of bacteria, *viz.*, *Staphylococcus aureus*, *Sarcina leutia*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas* sp. and *Xanthomonas* sp. Controls were

S. aureus, *E. coli* and *Pseudomonas* sp., than on *Xanthomonas* sp. and *S. leutia*.

Gupta *et al.* (*loc. cit.*) reported that the freshwater blue-green alga *Oscillatoria princeps* is very effective against *S. aureus* and *B. subtilis*, yielding zones 13 to 20 mm. wide. *Trichodesmium erythrœum* is equally effective against these bacteria, yielding zones of 19 to 22 mm. in width.

Our thanks are due to Prof. R. V. Seshaiya for suggesting the problem and for guidance and to the University Grants Commission for the award of Junior Research Fellowships.

Centre for Advanced   V. D. RAMAMURTHY.
Study in Marine Biology, S. KRISHNAMURTHY.
Porto Novo (S.India),
January 27, *1967.*

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HERMAPHRODITISM IN THE INDIAN SALMON *ELEUTHERONEMA TETRADACTYLUM* (SHAW)

INSTANCES of hermaphroditism have been recorded from a number of species of fishes such as *Hilsa ilisha*,[1] *Polynemusheptadactylus*,[2] *Rastrelliger canagurta*,[3] *Katsuwonus pelamis*,[4] *Cirrhina reba*,[5] *Barbus stigma*,[6] and *Mystus vittatus*[7] from Indian waters. While undertaking biological investigations of *Eleutheronema tetradactylum* in Chilka lake, the author came across a hermaphrodite specimen of 405 mm. in total length from the central part of the lake. The specimen did not show any abnormality both in external appearance and general internal anatomy. The left and right lobes of the gonad were identical with a length of 57 mm. and greatest diameter 12 mm. The ovarian regions of both lobes of the ovo-testes were yellowish, placed laterally touching the body wall and the testicular region of both lobes were milky white in colour facing each other in the body cavity. The ovarian region occupied a comparatively narrow portion of the gonad.

On microscopic examination it was found that in the ovarian region oocytes occurred in various stages of growth ranging in size from 0·07 mm. to 0·21 mm. The testicular region was separated from the ovarian region by a distinct layer of connective tissue (Fig. 1). The lobules in the testicular region were filled with mature spermatozoa. Normal gonads of other specimens of the same size-range collected simultaneously showed that the ovaries were in spent recovering stages whereas the testes were in slightly advanced stage of maturation.

The stage of maturation was identical in the ovo-testes except that from the texture it appeared maturing for the first time.

FIG. 1. Cross-section of ovo-testes showing oocytes (*oo*), Spermatozoa (*Sp*) and connective tissue (*c*).

In another instance also a specimen of total length 404 mm. collected from the lake showed hermaphrodite condition. The stage of maturation was the same as described above. Hermaphroditism in *Polynemus heptadactylus* has been thought to be of common occurrence (Nayak, 1959). The collection of a second specimen of *Eleutheronema tetradactylum* indicates that this phenomenon may not be very uncommon in this species also.

Central Inland Fisheries,   S. PATNAIK.
Cuttack,
Orissa (India), *May* 20, *1967.*

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AN OBSERVATION ON RECOVERY FROM MALFORMATIOH IN MANGO SAPLING

MALFORMATION in mango sapling comprises of numerous vegetative shoots at the growing point, giving a bunchy top appearance (Fig. 1). One species of phytophagous mite, *Aceria mangiferœ* Sayed (Eriophyidæ: Acarina) and four species of predatory mites are associated with malformed tissues (Narayanan and Ghai,

1964.. The mites are also observed on healthy shoots. Puttarudriah and Channabasavanna (1961) and Nariani and Seth (1962) reported that field collected eriophyid mites caused twig malformation on healthy mango saplings. Rai *et al.* (1966) found that diazinon and phorate emulsion sprays were very effective in killing *A. mangiferæ. in situ.* Summanwar *et al.* (1966) reported an association of a fungus, *Fusarium moniliforme* Sheld, with the malformation in mango.

Experiments were initiated to find whether by killing the mites with pesticides, it would be possible to have normal growth from malformed tissues of a sapling. Saplings showing bunchy top were utilized in the experiments. The terminal buds of shoots from the bunchy top were found to have large numbers of *A. mangiferæ.* Healthy shoots if any and all shoots except one from the bunchy top, of the malformed sapling were pruned. Further, a large proportion of axillary buds from the unpruned shoot were also scrapped, thus leaving only a terminal and a few axillary buds (Fig. 2). Five such pruned plants were sprayed upto dripping stage with 0·1% diazinon emulsion, for killing the mites. At different intervals after the treatment, the terminal buds of the shoots on all the diazinon treated saplings showed normal growth (Figs. 3 and 4), while the terminal buds of all the five unsprayed plants did not show any growth.

Arising of normal shoots from unaffected portions of malformed sapling is of quite common occurrence, but the development of a normal shoot from malformed bud itself after spraying with diazinon is considered to be of much significance which is likely to throw some light on the causation of and recovery from malformation, by further experimentation.

Thanks are due to Dr. S. Pradhan for useful suggestions and to Dr. S. K. Mukherjee for providing malformed mango saplings.

Division of Entomology,   B. K. RAI.
Indian Agri. Res. Institute,   NIRMOLINI SINGH.
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A NEW SPECIES OF *PHYLLOSTICTINA* ON *GLYCOSMIS* FROM COORG

THIS paper describes a new species of *Phyllostictina* Sydow collected by the writer on *Glycosmis pentaphylla* Correa from Coorg.

The species has been named as *Phyllostictina murnadensis* after the place where it was first collected. The English and Latin descriptions are given below:

Phyllostictina murnadensis PONNAPPA SPEC. NOV.
(FIG. 1).

FIGS. 1–4. Fig. 1. Malformed mango sapling. Fig. 2. Pruned mango sapling. Fig. 3. Pruned mango sapling showing growth after spraying with diazinon. Fig. 4. Pruned mango sapling showing growth after spraying with diazinon.

FIG. 1. *Phyllostictina murnadensis* Ponnappa spec. nov. A. Pycnidium; B. Conidiophores with conidia attached; C. Spores.

Leaf spots circular to oval, amphigenous, dirty white or brown in the centre with dark red, raised circular periphery, few to many, adjacent spots tending to coalesce assuming

various shapes. Pycnidia amphigenous, epiphyllous, few to many, scattered, sometimes gregarious, brown to light brown, innate, pseudoparenchymatous, depressed-globose, pycnidial wall consisting of 1–2 layers of light brown cells, with a prominent ostiole, 308–336 μ in diameter. Conidiophores simple, cylindrical, straight or bent, $13 \cdot 95 \times 1 \cdot 86$ ($11 \cdot 16$–$18 \cdot 6 \times 1 \cdot 86$–$2 \cdot 0) \mu$. Pycnidiospores hyaline, unicellular, globose, $3 \cdot 72$–$11 \cdot 16$ or ellipsoidal $13 \cdot 39 \times 10 \cdot 40$ ($14 \cdot 38$–$13 \cdot 02 \times 11 \cdot 16$–$9 \cdot 36) \mu$ covered by a mucilaginous envelope, frequently forming a filiform appendage at the apical end in majority of spores.

On living leaves of *Glycosmis pentaphylla* Correa (Rutaceæ) 5-5-1966. Murnad-Coorg (Mysore State), K. M. Ponnappa. Herb. IMI 120705.

Foliorum maculæ circulares vel ovales, amphigenæ, sordide albæ, vel brunneæ in centro, peripheria fusce rubra elevata circulari, maculis paucis vel pluribus adjacentibus ad coalescentiam tendentibus, formas varias adsumentibus. Pycnidia amphigena, epiphylla, pauca vel plura dispersa, interdum gregaria, brunnea vel pallide brunnea, innata, pseudoparenchymatica, depresso-globosa, parietibus constantibus serie unica vel duplici cellularum pallide brunnearum, ostiolo eminenti, 308–336 μ diam. Conidiophora simplicia, cylindrica, recta vel curva, $13 \cdot 95 \times 1 \cdot 86$ ($11 \cdot 16$–$18 \cdot 6 \times 1 \cdot 86$–$2 \cdot 0) \mu$. Pycnosporæ hyalinæ, unicellulares, globosæ, $3 \cdot 72$–$11 \cdot 16$ vel ellipsoideæ, $13 \cdot 39 \times 10 \cdot 40$ ($14 \cdot 38$–$13 \cdot 02 \times 11 \cdot 16$–$9 \cdot 36) \mu$ opertæ involucro mucoso, sæpe efformantes appendicem filiformem ad apicem in sporis plurimis.

In foliis viventibus *Glycosmis pentaphyllæ* Correa e familia Rutacearum, 5-5-1966. Murnad-Coorg (Mysore State), K. M. Ponnappa. Herb. IMI 120705.

The author is grateful to Dr. V. P. Rao, Entomologist-in-charge of CIBC, Indian Station, for his keen interest and kind encouragement. He is highly indebted to Dr. E. M. Mordue, Commonwealth Mycological Institute, London, for identifying the fungus. Grateful thanks are due to Dr. S. K. Mukerjee, Botanical Survey of India, for identifying the plant and to Dr. H. Santapau, S.J., for rendering the diagnosis into Latin.

Commonwealth Inst. of   K. M. PONNAPPA.
  Biological Control,
Indian Station,
Bellary Road,
Bangalore-6, *March* 27, 1967.

OCCURRENCE OF *HIRSUTELLA VERSICOLOR* PETCH ON MANGO LEAF HOPPER (*IDIOCEROS* SP.) IN INDIA

MANGO leaf hopper (*Idioceros* sp.) is an important pest of young twigs and blossoms of mango throughout the mango growing tracts in India. They damage the young and growing twigs and suck the juice of flowers. In the months of January-February in mango orchards of Bihar they are often observed to die and the dead pests fall on the ground either being detached from the leaves or along with the falling leaves. A large number of such fallen leaves were examined and found to contain dead pests. The presence of a fungus consistently associated with the dead insects proved on examination to be a species of *Hirsutella*.

The affected insects which are killed by the fungus remain attached mostly to the undersurface of the leaves and the mycelia are found to radiate on the sides to form a mat over the leaf surface (Fig. 1). Stromata on the insect is compact exhibiting white, greyish-white, dark ochracious, greyish-brown or orange-yellow colouration at different stages.

The fungus is entomogenous. Synnemata are lacking. Phialides are lateral on the hyphæ, more or less flask-shaped measuring $2 \cdot 5$–$3 \cdot 5 \times 4$–14μ attenuated into one to two and rarely three sterigmata measuring 4–9 μ in length (Figs. 2 and 3). A single conidium is borne on each sterigma. Conidia are hyaline, devoid of any gelatenous matrix, globose, measuring 3–4 μ in diameter.

FIGS. 1–3

Hirsutella versicolor Petch has been described on *Idioceros* sp., from Ceylon in 1932 by Petch[1] who has decribed two types of conidia in the same species, the narrow oval type (4–8 $\mu \times \cdot 75$–$1 \cdot 5 \mu$) and the globose type

measuring $3-4\,\mu$ in diameter, which he has referred to as "sessile globose pseudoconidia $3-4\,\mu$ diameter". But in the fungus under study only the globose type of conidia were found. A bit of the specimen was sent to Dr. Agnes H. S. Brown who kindly got it com·· pared with an authentic specimen of *Hirsutella versicolor* Petch preserved in the Herbarium of the Commonwealth Mycological Institute, England, and found them to be similar. Hence the fungus under study may be referred to the same species. Even in the authentic specimen only the globose type of conidia could be found.

The only other report of a species of *Hirsutella* with globose conidia is *Hirsutella thompsonii* Fisher described on *Phyllocoptruta oleivord* (Ashm)[2] from Florida, U.S.A. The conidia in this species are slightly smaller ($2\cdot1-3\cdot3\,\mu \times 2\cdot1-3\cdot3\,\mu$) but other general features are not much in common between the two species.

The specimen has been depsited in Herb. C.M.I., England. The author wishes to record his grateful thanks to Dr. Agnes H. S. Brown, C.M.I., England, for the valuable help rendered in the identification of the fungus.

Plant Pathology   B. P. CHAKRAVARTI.
   Research Division,
Agricultural Experiment
   Station, University of Udaipur,
Udaipur, *November* 5, 1966.

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PHAEOTRICHOCONIS TERRESTRE SP. NOV., FROM SOIL

DURING the course of investigation of rhizosphere mycoflora of *Ocimum sanctum* Linn. a new species of *Phœotrichoconis* was isolated. The cultural study of the fungus was done at 25° C.

Phœotrichoconis terrestre SP. NOV.

Colonies on oat-meal agar bearing aerial floccose hyphæ brownish to blackish in colour, $3\cdot3-5\,\mu$ thick, branched, septate when mature at the intervals of $20-28\,\mu$, branches almost at right angles to the main axis; conidiophores not easily distinguishable from hyphæ, septate with swollen apex, $40-100 \times 3\cdot3-5\,\mu$, bearing single conidium at the tip. Conidia elongate, fusiform with a long appendage at the apex, attached by their broad end with conidiophores, having a dark scar showing the point of attachment, transversely septate, septa 4–6 in number, dark brown, thick-walled with granular

contents, not constricted at septum, second and third cells from the base larger than rest of cells, $38-55 \times 14\cdot8-17\cdot2\,\mu$; appendages smaller than conidia, hyaline, aseptate, erect, $30-40 \times 1\cdot5\,\mu$; dark black sclerotia develop in the culture after a week, circular to irregular provided with many hyaline stiff bristles $33-120\,\mu$ in diameter.

The fungus was isolated by P. C. Gupta from rhizosphere of *Ocimum sanctum* Linn. in September 1966, and will be deposited in Herb I.M.I., Kew.

FIGS. 1–3. *Phœotrichoconis terrestre* sp. nov., Fig. 1 Conidia. Fig. 2. Conidiophores. Fig. 3. Sclerotia with hyaline bristles.

Phœotrichoconis terrestre SP. NOV.

Coloniæ in agaro ordeaceo producentes hyphas æthereas floccosas, brunneas vel nigreolas, $3\cdot3-5\,\mu$ crassas, furcatas, septatas ad maturitatem, angulum rectum efformantes cum axi principe ad ramificationem. Conidiophoris haud faciliter distinguendæ hyphis, erecta, septata apice tumescente, $40-100 \times 3\cdot3-5\,\mu$, singula conidium unicum ad apicem supportantia. Conidia elongatofusiformia, appendice longa ad apicem ornata, conidiophoris fixa per apicem latiorem, prædita cicatrice fusca monstrante punctum unionis, transverse septata, septis 4–6 numero, fusce brunnea, parietibus crassis et contentis granularibus, haud constricta ad septa; cellula secunda et tertia a basi cellulis cæteris majores, $38-55 \times 14\cdot8-17\cdot2\,\mu$, appendices

conidiis minores, hyalinæ, aseptatæ, erectae, $30–40 \times 1 \cdot 5\,\mu$; sclerotia fusco-nigra evolvuntur in cultura post dies septem, circularia vel irregularia, pluribus setis hyalinis rigidis ornata, $30–120\,\mu$ diam.

Lectus a P. C. Gupta ex rhizosphæra *Ocimi sancti* mense Septembri 1966.

The genus *Phæotrichoconis* was established by Subramanian (1956) describing the type species *P. crotalariæ*. The present species differs from the type species markedly in (*i*) having smaller conidia, (*ii*) straight append- ages and (*iii*) appendages smaller than conidia. Therefore a new species, *viz.*, *Phæotrichoconis terrestre* is being proposed to accommodate it.

Sincere thanks are due to Fr. Dr. H. Santapau for the Latin diagnosis and to Prof. R. Misra for providing laboratory facilities.

Department of Botany,   R. Y. Roy.
Banaras Hindu University,   P. C. Gupta.
Varanasi-5, *January* 9, 1967.

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CHROMOSOME NUMBERS IN SOME LOCAL CENTROSPERMOUS WEEDS

Of the several centrospermous weeds in the local flora, only three constitute the subject-matter of this report. *Mollugo lotoides* O. Kze. (*M. hirta* Thunb.) is supposed to be a polymorphic species.[3] It appears to have a wide range of phenotypic plasticity in the local flora. All the phenotypes on cytological investigation, however, prove to be paramorph of the same number. This may be ascribed to genotypic flexibility. PMCs at active stages of division were squashed in acetocarmine and 18 bivalents were scored at diakinesis and metaphase 1 (Fig. 1). Pairing was found to be regular. The plant is a self-breeder and this coupled with normal pairing may lead to the inference that it is a diploid with $n = 18$. But this type of wide range of tolerance and phenotypic plasti- city does not appear to be explainable in terms of diploidy, more so in a ruderal like this. It is probable that this type of normal diploid behaviour has been acquired during long range successive autogamy with gradual decrease in heterozygosity.

TABLE I

Name of species	Numbers reported	Authors
Mullugo lotoides	$n = 18$	Sinha and Singh, 1967
M. spergula ..	$n = 18$	Raghavan and Srinivasan, 1940
Saponaria vaccaria	$n = 15$	Sinha and Singh, 1967

The other species under reference is *M. spergula* L. (*M. oppositifolia* L.) which is less abundant and has a narrow range of phenotypic expression. Here too 18 bivalents were seen at diakinesis and metaphase 1. The number for this species is the same as reported earlier.[1]

FIGS. 1–2. Fig. 1. Photomicrographs of metaphase 1 showing 18_{II} of *Mollugo lotoides*, $\times 1,250$. Fig. 2. Photo- micrographs of metaphase 1 showing 15_{II} of *Saponaria vaccaria*, $\times 1,250$.

In *Saponaria vaccaria* L. (*S. perfoliata* L.) growing as a weed[2] of 'Rabbi' crop here 15 bivalents could be seen (Fig. 2). In other species of the genus the number reported is $2n = 28$ but the present investigation appears to have pointed out that the genus may be dibasic with both 14 and 15 as base numbers.

Thanks are due to Prof. R. P. Roy for helpful criticism and for providing necessary facilities during the course of this investigation.

Department of Botany,   R. P. Sinha.
Patna University,   M. K. Singh.
Patna-5, *July* 19, 1967.

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REVIEWS AND NOTICES OF BOOKS

Symposia of the International Society for Cell Biology (Vol. 5). Edited by Katherine B. Warren. (Academic Press, Inc., New York and London), 1967. Pp. xvii + 325. Price $ 15.00.

This volume presents a series of papers by eminent engineers and biologists concerning the movement of molecules within cells—a subject that has received comparatively little attention. In these papers, fundamental problems are defined and valuable analyses of the mechanisms for intracellular transport are provided.

The titles of, the chapters contained in this volume are : The Unit Membrane and the Danielli-Davson Model ; Intracellular Transport in the Amœba *Chaos Chaos ;* Intracellular Transport Fluxes—Can They Be Accurately Determined ? Structural and Functional Organization of an Epithelial Cell Brush Border ; Fine Structural Localization of Adenine Nucleoside Phosphatase Activity in the Sacroplasmic Reticulum of Striated Muscle ; Na-Dependent Transport of γ-Aminobutyric Acid in Subcellular Brain Particles ; Intracellular Potentials in Frog Skin and Toad Bladder ; Some Theoretical Aspects of Biological Transport ; Compartmental Analysis and Theory of Residence Time Distributions ; Parametric Pumping : A Model for Active Transport ; A Physicochemical Basis for Pattern and Rhythm ; Transport in, Liquid Systems with Diffusion and Reaction Coupling ; On the Behavior of Rotating Helices ; and Thoughts about the Mechanism of Membrane Movements.

This book will be found to be of interest by cell biologists, pharmacologists, geneticists, biophysicists and neurologists.　　C. V. R.

Design and Analysis of Scientific Experiments. By Mr. Kan-Chen Peng. (Addison Wesley Publishing Co., Inc., 10-15, Chitty Street, London, W. 1), 1967. Pp. ix + 252. Price $ 12.50.

Designed for statisticians, computer programmers, and persons engaged in experimental work, this introductory book assumes a background of calculus, elementary matrix theory, and the equivalent of a one-year course in statistics.

A blending of theory, application, and computational procedures, the book discusses the essential ideas of estimations, constructing common experimental designs, and testing hypotheses as seen from the viewpoint of statistics. General procedures for the numerical computations in analysis of variance are described, and basic information on analysis of covariance is presented, along with a number of complex experiments. Certain techniques are introduced in such a way as to be easily programmed for a digital computer; however, a computer programming background is not required. Features of the book include a streamlined general computation procedure for multiple covariance analysis, detailed discussions of response surface designs, and the group theoretic treatment of fractional factorial designs.　　C. V. R.

Weather Prediction by Numerical Process. By Lewis F. Richardson. (Dover Publications, Inc., 180, Varick Street, New York, N.Y. 10014), 1965. xvi + 236. Price $ 2.00.

This Dover edition, first published in 1965, is an unabridged and unaltered republication of the work first published by Cambridge University Press, London, in 1922, to which has been added a new introduction by Sydney Chapman of the Institute of Science and Technology, University of Michigan.

The contents of this book are : I. Summary ; II. Introductory Example ; III. The Choice of Co-ordinate Differences ; IV. The Fundamental Equations ; V. Finding The Vertical Velocity ; VI. Special Treatment for the Stratosphere ; VII. The Arrangement of Points and Instants ; VIII. Review of Operations in Sequence ; IX. An Example Worked on Computing Forms ; X. Smoothing the Initial Data ; XI. Some Remaining Problems ; and XII. Units and Notation.　　C. V. R.

Annual Review of Pharmacology (Vol. 7). Edited by H. W. Elliott. (Annual Reviews, Inc., Palo Alto, California 94306, U.S.A.), 1967. Pp. vii + 405. Price $ 8.50 per copy (U.S.A.) and $ 9.00. (Elsewhere).

The contents of this volume are : Pharmacology in Old and Modern Medicine ; Biochemical Mechanisms of Drug Action ; Mechanisms of Drug Absorption and Excretion ; Metabolic Fate of Drugs : Barbiturates and Closely

Related Compounds; Parasite Chemotherapy; Cancer Chemotherapy with Purine and Pyrimidine Analogues; Electrolytes and Excitable Tissues; Cardiovascular Parmacology; Renal Pharmacology; The Autonomic Nervous System; Histochemistry of Nervous Tissues: Catecholamines and Cholinesteratses; Pharmacology of the Central Cholinergic Synapses; Neuromuscular Pharmacology; Narcotic and Narcotic Antagonist Analgssics; Psychotomimetic Agents; Pesticides; Aflatoxins; Toxicological Safety of Irradiated Foods; Antifertility Agents; and Why Do Thiazide Diuretics Lower Blood Pressure in Essential Hypertension?

C. V. R.

Problems and Solutions in Mathematical Physics. By Y. Choquet-Bruhat. (Holden-Day, Inc., 500, Sansome Street, Sanfrancisco), 1967. Pp. vii + 314. Price $ 10.00.

This is a translation of the original book written in French by Madame Choquet-Bruhat, a professor at the Sorbonne. This compilation of problems and solutions in mathematical physics will introduce students of physics and engineering to some of the modern mathematical concepts and techniques which are assuming importance in the physical sciences. The problems relate to classical as well as modern physics and each problem is followed by its solution.

The book is divided into two parts. The first part on Linear Algebra and Analysis contains problems on operations on matrices, reduction of matrices, Hermitian operators, Vector calculus and multiple integrals. The second part on Function Spaces, Integral and Differential Operators contains problems on function spaces and operators, series expansions of functions, differential equations and partial differential equations.

The book will be useful to teachers in need of examples to supplement their lectures. It will provide good material for students for practice and self-study.   A. S. G.

Industrial Chemistry (*Technology of Indian Chemical Industries*). By R. C. Bhattacharjee (Inter-University Press, P. Ltd., 1, Ansari Road, Darya Ganj, Delhi), 1967. Pp. 218. Price Rs. 15.00.

The sub-title indicates the object of this publication. Development of a chemical industry depends on such important factors as raw materials, equipments and the know-how of manufacture. The author gives concise but comprehensive information on a number of products of chemical industrial interest that have developed in the country in recent years. Emphasis is on the available sources of indigenous raw materials equipments and technological processes in use. One can find much useful and up-to-date information collected in this publication. The book will interest not only students of industrial chemistry, but laymen also wishing to know about the country's development in this direction, and entrepreneurs interested in small-scale chemical industrial products. Printing and get-up could have been better; however, the author's object is "to price the book very modestly". The text is not altogether free from errors as for example "Iron has its atomic weight 66·85" (p. 134).   A. S. G.

Fundamental University Physics (Vols. I and II). By Marcelo Alonso and Edward J. Finn. (Addison Wesley Publishing, Co., Ind., 10-15, Chitty Street, London, W. 1), 1967.
Volume I: *Mechanics,* Pp. 435 + App. 28. Price $ 8.75.
Volume II: *Fields and Waves,* Pp. 437–965 + App. 28. Price $ 8.75.

There is a need for a publication of this type which will assist progressive physics instructors who strive to improve the courses they teach. The 3-volume publication presents the fundamental ideas that constitute the core of today's physics. It is intended as a three Semester course on general physics for students majoring in science and engineering. The authors have given a unified presentation of the subject emphasising the conservation laws, the concepts of fields and waves and the atomic view of matter. The branches included are: (1) Mechanics, (2) Interactions and Fields, (3) Waves, (4) Quantum Physics and (5) Statistical Physics.

The two volumes under review deal with the first three branches of the general course covering non-quantum physics. To assist the instructor the authors have suggested a time schedule of teaching which indicates the number of hours to be devoted to each topic so that the semester course could be covered in 43 lecture hours. Many worked examples and problems are included in each chapter.

A. S. G.

Advances in Agronomy (Vol. 18). Edited by A. G. Norman. (Academic Press, Inc., Publishers. 111, Fifth Avenue, New York, N.Y. 10003). 1966. Pp. 392. Price $ 15.00.

The volume contains seven chapters bearing on agronomic science and technology. In the first article R. C. Rossiter reviews the physiology and ecology of annual pastures in Australia. This general area has become something of a speciality of Australian workers whose contributions have been distinguished. The second article on soil aeration and plant growth by A. R. Grable critically examines the physical processes by which O_2 and CO_2 move within soil-plant systems, and considers the interrelation of soil aeration with other soil properties. Another contribution on soils is the one by R. F. Harris, G. Chesters and O. N. Allen dealing with the dynamics of soil aggregation.

One of the chief interests of ecologists and agriculturists which is being pursued now is the correlation of productivity with environment. The basic problem in this study involves a clear understanding of the energy exchange in the organism-environment system. Review of literature on this aspect is presented by S. B. Idso, D. G. Baker and D. M. Gates in their article "The Energy Environment of Plants". Marked progress has been made during the past decade in our understanding of what happens to nitrogen fertilizers applied to soils. Modern techniques like ^{15}N-tagged fertilizers, gas chromatography, etc., are helping to throw more light on the subject. Some recent results have been reviewed by F. E. Allison in the article "The Fate of Nitrogen Applied to Soils."

The advances made in turfgrass management have been due to a few dedicated people having research and educational assignments, working very closely with green keepers, golf course superintendents, park operators, and turf managers. W. H. Daniel and E. C. Roberts of Purdue University have brought together in a useful way the progress of work during the past 25 years in this field of Turfgrass Management in the United States. In the last article of the volume D. Swartzendruber examines the theory of soil-water movement in the light of flow response to pressure-gravity gradient.

A. S. G.

Plywood Research Souvenir. (The Indian Plywood Industries Research Association. Post Bag No. 3, Tumkur Road, Bangalore-22). Pp. 130. Price Rs. 7·00.

The Indian Plywood Research Association has brought out a *Souvenir* on the occasion of the inauguration in Bangalore of the Association's new buildings housing the laboratories, on June 30, 1967. The *Souvenir* contains 27 articles on scientific, industrial and technological aspects of plywood and plywood products. The contributors are all from outside India, mostly from America and Germany, who are intimately connected with plywood research and plywood industry and trade.

The plywood industry in America which originally used only high quality logs of a single species, namely Douglas-fir, has grown to a point where today 28 soft wood species are used in its manufacture from the Pacific to the Atlantic coast. The same growth should be evident in other advanced industrial countries as well. It is the technological progress through specialised research that has paved the way for this development.

In India plywood industry is becoming an important industry and rapid progress can be achieved only when the industry is backed by good scientific and technological support. There has been notable contributions from Indian research workers also in this field.

The contributed articles in the *Souvenir* cover a wide range of topics of current interest in plywood research and include recent studies on cellulose fibres, hygroscopicity and grain structure, wood extractives and gluing properties, wood adhesives, coated abrasives and machining, wood-improvement by impregnation with monomers and their polymerisation by gamma-rays, non-destructive testing of wood, wood as a mobile neutron shielding material for reactors, etc. Four articles are in German and one in French.

Dr. D. Narayanamurti, the Director of the Research Laboratories, who himself has made no mean contribution to plywood research in India with special reference to wood adhesives which has been quoted in these articles, deserves congratulation on having brought out so useful a *Souvenir* on this occasion. A. S. G.

A NEW ELECTRONIC TRANSITION OF S_2 IN THE VACUUM ULTRAVIOLET REGION

G. LAKSHMINARAYANA AND N. A. NARASIMHAM

Spectroscopy Division, Bhabha Atomic Research Centre, Modular Laboratories, Trombay Bombay-74

TANAKA AND OGAWA,[1] in the course of their investigations on the emission spectrum of S_2 in the vacuum ultraviolet, observed four new band systems in the region 1750–2130 Å. From a study of their vibrational structure, they showed that three of the band systems involved transitions to a common lower electronic state, x, and the fourth band system to the ground state, $X\ ^3\Sigma_g$. They also obtained in emission the band systems, C–X and D–X, which were known earlier in absorption. These bands were however very much weaker compared to the new band systems. During the course of our studies on the emission spectrum of S_2, we have been able to record all the bands reported by Tanaka and Ogawa and, in addition, a new band system containing a single v''-progression of bands. The present note gives the vibrational structure of these new bands.

The emission spectrum of S_2 has been excited in an electrodeless microwave discharge (2450 Mc/sec. at 90 watts power) through sulphur and helium at a pressure of 2–3 mm. of Hg under static condition. The resulting spectrum has been photographed on a 3 m. normal incidence vacuum grating spectrograph having a plate factor of 2·9 A/mm. The new band system lies in the region 1780–1850 Å and is shown in Fig. 1. As can be seen from the spectrogram, the bands are all degraded to shorter wavelengths. Each band consists of a P head and a Q head and their average separation is about 9 cm.$^{-1}$ Such a band structure is characteristic of an electronic transition involving $\Delta\Lambda = \pm 1$. The wave number data of the P-heads of the four new bands are given in the Deslandres Table I. They form a v''-progression with $v' = 0$. The upper vibrational level v' is not uniquely determined to be zero. The $\Delta G''(1/2)$, $\Delta G''(3/2)$ and $\Delta G''(5/2)$ values as well as the second differences $\Delta^2 G''$ are given below the band head data. They agree well with the corresponding values of the x state of Tanaka and Ogawa which are also included in the table in italics for comparison. It is therefore evident that the new bands arise from a new electronic level to the x state of Tanaka and Ogawa.

TABLE I

Deslandres scheme of vacuum wave numbers of the band heads of the new system

v' \ v''	0	1	2	3
0	56077·7	55385·5	54698·1	54016·1
$\Delta G'' (v+1/2)$		692·2	687·4	682·0
		693·0	*686·3*	*679·6*
$\Delta^2 G$			4·7	5·4

Values of $\Delta G'' (v+1/2)$ given in italics are from the data of Tanaka and Ogawa.

The e-X bands also occur in the same spectral region (Fig. 1). They are also found to be

1783·24 Å   1805·52 Å   1828·22 Å   1851·30 Å
0-0   0-1   0-2   0-3

NEW SYSTEM

1-1 (c'-x)

e-X SYSTEM
0-0   0-1   0-2   0-3   0-4
1782·25 Å SI   1807·31 Å SI   1826·25 Å SI
1820·37 Å SI

C-X SYSTEM
0-0   0-1   1-3 0-2

FIG. 1. Emission spectrum of S_2.

double-headed with an average separation of about 14 cm.$^{-1}$

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$\left[\begin{array}{c} Cur' \\ Sc' \end{array}\right.$

ELECTRON SPIN RESONANCE IN X-IRRADIATED SODIUM SULPHATE

N. HARIHARAN AND J. SOBHANADRI

Department of Physics, Indian Institute of Technology, Madras-36

SINGLE crystals of Na_2SO_4 were irradiated with X-rays from a copper target (30 KV, 15 mA) and Electron Spin Resonance Spectra of the induced magnetic centres were obtained with X-band spectrometer (Varian Model V 4500) mainly at room temperature. The crystals were rotated about three orthogonal crystallographic axes every five degrees. The single crystals were grown from aqueous solution by slow evaporation and repeated crystallisation. From X-ray diffraction measurements the orthorhombic unit of Na_2SO_4 is found to have the unit cell dimensions $a_0 = 5\cdot85$, $b_0 = 12\cdot29$ and $c_0 = 9\cdot75$ A with 8 molecules per unit cell agreeing with the previous work.[1] The crystals, on irradiation, slowly developed a beautiful purple coloration.

The observed E.S.R. spectra consist of several lines. Figure 1 shows some typical spectra.

FIG. 1. Derivative of E.S.R. spectra of the irradiated single crystal of Na_2SO_4. The magnetic field is rotated in the ac plane of the crystal and angles are measured from the a axis.

The centres are all found to be stable for days in the dark at room temperature.

Line A is almost isotropic with average g factor of $2\cdot0045$ and a width of about 10 Gauss.

This can be attributed to paramagnetic ce' SO_3^- present in the crystal. Optical absorp' measurements show that both SO_2^- and S' may be present in the X-irradiated cry' Previous work[2,3] on other sulphates reveal '' SO_2^- is isotropic with g value $2\cdot004$ and S' has principal g values $2\cdot0024$, $2\cdot0102$ and $2\cdot0''$ It is possible that lines due to SO_2^- and S' may be overlapping thus giving rise to a br' spectrum. Further analysis on the fine struct'' and on the angular variation, which are progress, may throw more light on this probl'' E.S.R. spectra of X-irradiated powder of Na_2S' were also measured and they also give li' with g value near $2\cdot004$.

Line C has g value near $2\cdot03$. This is sim'' to the resonance line observed in X-irradia'' $Na_2S_2O_3.5 H_2O$ by Golding and De Lisle[3] wh'' they have attributed to sulphur radical. Oti' work[4,5] on the electron spin resonance of sulph'' also reveal a similar resonance line.

Group B contains two to three lines in t'' central region of the E.S.R. spectra with g val'' varying from $2\cdot004$ to $2\cdot03$. The observed lar'' anisotropy of g values suggests that the'' centres may contain some other ions associat'' with sulphur.

Other analogous sulphates are found to ha'' SO_3^- and SO_4^- centres created by irradiatio''' Further analyses on sodium sulphate which a''' in progress will reveal more details about th'' centres present and their structure.

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THE A-X BAND SYSTEM OF THE COPPER CHLORIDE MOLECULE

K. P. R. NAIR AND K. N. UPADHYA

Department of Spectroscopy, Banaras Hindu University, Varanasi-5

THE spectra of copper chloride have been studied extensively. Six band systems, all degraded to red, have been identified by Ritschl[1] in the region 3700–5100 Å. The vibrational assignments for the bands were supported by the measurement of the isotope shifts. The spectra were also studied in emission from flames containing CuCl vapour[2,3] and also in the emission from solid Cu_2Cl_2 bombarded by active nitrogen.[4]

A spec-pure sample of Cu_2Cl_2 was spread in the middle part of a conventional π type discharge tube having nickel electrodes. Tre bands were best developed in an intense bluish discharge. Exposures of $1\frac{1}{2}$ hours duration were found sufficient to photograph the bands in the first order with good intensity.

The bands are double headed as shown in Fig. 1 and because the lower state is a $^1\Sigma^+$ state,

FIG. 1. (0, 0) band of the A-X system of CuCl.

The rotational structure of the (0,0) bands of the D-X and E-X systems were partially analysed by Terrien.[5] The analysis is complicated due to the presence of isotopes and Rao and Brody[6] have used separated isotopes of copper and chlorine to minimise this difficulty. Rao, Asundi and Brody[7] photographed the spectra under high resolution and analysed the rotational structure of the B-X, C-X, D-X, E-X, and F-X band systems of $Cu^{65}Cl^{35}$ molecule. The A-X band system was not rotationally analysed because of the close packing of bands in a sequence and consequent overlapping of the structure. We have now succeeded in photographing these bands on the 35-foot concave grating spectrograph and have determined the rotational constants for the A state. The bands are very weak and lie in a region far removed from the blaze region of our grating and we could photograph these only in the first order with a dispersion of 0·7 Å/mm.

The bands were excited in a transformer discharge through the flowing vapour of Cu_2Cl_2.

the upper state is expected to be a $^1\pi$ state. The Q head is expected to be very close to the origin of the band and hence the separation between the two heads may be taken as the head-origin separation. The prominent bands are due to the isotopic species $Cu^{63}Cl^{35}$ as this is the most abundant in a natural sample of CuCl. The band heads due to $Cu^{65}Cl^{35}$ have been observed clearly for the (0, 1) band. The constants for the ground state of $Cu^{63}Cl^{35}$ have been obtained from the ground state constants for $Cu^{65}Cl^{35}$ obtained by Rao, Asundi and Brody[7] from the relation $B^i = \rho^2 B$ where i refers to the isotopic molecule $Cu^{65}Cl^{35}$. Using the rotational constants for the X state thus obtained, the rotational constants for the A state have been estimated from the relation :

$$\nu_R - \nu_Q = -\frac{(B_{v'} + B_{v''})}{4} \frac{}{(B_{v'} - B_{v''})}.$$

The various constants determined are collected in Tables I and II.

TABLE I

The head-origin separation and the rotational constants from the bands of the A-X system

Band	R head (cm.⁻¹)		Q head (cm.⁻¹)		$\nu_H-\nu_0$ (cm.⁻¹)		B" (cm.⁻¹)		B' (cm.⁻¹)		
	$Cu^{63}Cl^{35}$	$Cu^{65}Cl^{35}$	$Cu^{63}Cl^{35}$	$Cu^{65}Cl^{35}$	$Cu^{63}Cl^{35}$	$Cu^{65}Cl^{35}$	$Cu^{63}Cl^{35}$	$Cu^{65}Cl^{35}$*	$Cu^{63}Cl^{35}$	$Cu^{65}Cl^{35}$ (cal. from $Cu^{63}Cl^{35}$)	$Cu^{63}Cl^{35}$
0, 0	18997·33	..	18994·21	..	3·12	..	0.1777_9	0·1759	0·1682	0·1664	..
1, 1	18988·96	..	18985·78	..	3·18	..	0.1767_8	0·1749	0·1674	0·1656	..
0, 1	18583·25	18585·42	18579·77	18582·00	3·48	3·42	0.1767_8	0·1749	0·1682	0·1664	0·1...

* *Can. J. Phys.*, **40**, 412, 423 and 1443 (1962).   B" for $Cu^{63}Cl^{35}$ were calculated from B" for Cu^{65}...

TABLE II

Molecular constants for the A state of CuCl

Molecule	B_e (cm.⁻¹)	α_e (cm.⁻¹)	r_c (Å)
$Cu^{63}Cl^{35}$	0·1686	0·0008	2.108_9
$Cu^{65}Cl^{35}$	0·1667	0·0007	2.109_1

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EVIDENCE OF THE INFLUENCE OF CRYSTAL DEFECTS ON THE ANNEALING OF CHEMICAL RADIATION DAMAGE

S. R. MOHANTY AND S. M. K. NAIR

Radiochemical Laboratory, Banaras Hindu University, Varanasi-5, India

MADDOCK AND CO-WORKERS[1] have recently shown that crystal defects determine the fate of the fragments generated in solids by the Szilard-Chalmers process, as well as the kinetics of subsequent annealing reactions. The possibility that crystal defects may equally be of importance in chemical radiation damage led Mohanty and Upadhyay[2-4] to the discovery that compression and crushing induce direct recovery of such damage and also accelerate the thermal annealing process. Andersen,[5] and Khare and Mohanty[6] have observed annealing in irradiated potassium bromate by compression. A brief account of some new observations on annealing in lead nitrate containing lattice defects introduced by doping and fast neutron bombardment is given below.

Homogeneous crystals of lead nitrate containing various concentrations of aluminium ions in the range 10^{-4} and 10^{-1} mole fraction were prepared by slow evaporation of aqueous solutions. Vacancies are generated by such addition of small concentrations of ions bearing a charge different to the corresponding ions in the host

lattice. For example, it has been found that each calcium ion incorporated into a potassium chloride lattice results in the simultaneous inclusion of a cation vacancy.[7] Samples of the untreated and doped crystals were irradiated under identical conditions with 50 Mrad of 60Co γ-radiations at the dose rate of 1·5 Mrad hr. The initial damage, measured as nitrite, was larger the higher the concentration of the impurity ions :

Al, Mole fraction	0	10^{-4}	10^{-3}	10^{-2}	$10...$
NO_2^-, ppm	1793	1909	1961	2085	209...

The thermal annealing characteristic for lead nitrate containing 10^{-2} mole fraction of aluminium is shown in Fig. 1 along with that for the untreated substance. It is seen that doping accelerates the annealing process. Thus whereas the fraction φ of the initial damage annealed on 35 hr. heating at 150° C. was 0·3... for the untreated crystals it was 0·501 in the case of the doped material.

A comparison has been made of the initial damage and the thermal annealing behaviour

of lead nitrate irradiated with 50 Mrad of ^{60}Co γ-rays with the substance irradiated close to the reactor core so as to receive the above dose of γ-rays and, in addition, 5×10^{15} nvt fast and $2 \cdot 2 \times 10^{16}$ nvt slow neutrons. In the latter case,

FIG. 1.

apart from the chemical damage produced by the γ-rays, and the 45 Kev ^{14}C atoms and the 0·56 Mev protons from the ^{14}N (n, p) ^{14}C reaction, a considerable concentration of displacements is produced by the knock-on collisions of chiefly the fast neutrons. The initial chemical damage in irradiation with only γ-rays (1670 ppm) is smaller than that with γ-rays *plus* neutrons

(2922 ppm). The annealing rate is higher in the latter case (Fig. 1). For example, the fraction annealed on 35 hr. heating at 150° C. was 0·366 for the γ-irradiated lead nitrate and 0·560 for the substance irradiated in the reactor. It has been already found[8] that the annealing characteristic at a given temperature is independent, over wide limits, of the energy, the dose rate and the dose of γ-rays. It would appear therefore that lattice defects are responsible for the higher annealing observed with the reactor irradiated lead nitrate than with the substance irradiated with only γ-rays.

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OXIDATION OF THIOUREA BY AMMONIUM HEXANITRATO CERATE IN TRI-*n*-BUTYL PHOSPHATE

H. C. MRUTHYUNJAYA

Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore-12

A SOLUTION of ammonium hexanitrato cerate in tri-*n*-butyl phosphate suitably diluted with carbon tetrachloride (1 : 4 by volume) has been observed to be a good oxidising agent for the potentiometric titrations of hydroquinone, sodium iodide, ascorbic acid, ferrous chloride and potassium ferrocyanide dissolved in either glacial acetic acid or TBP-carbon tetrachloride mixed solvent.[1] The same reagent taken in excess has been found to oxidise thiourea dissolved in glacial acetic acid quantitatively to formamidine disulphide base. One equivalent of the oxidising agent is consumed for every mole of thiourea. An analytical procedure has been evolved for the estimation of thiourea dissolved in acetic acid, based on this reaction.

0·02 M solution of ammonium hexanitrato cerate in the TBP-carbon tetrachloride mixed solvent is prepared from the stock solution. The exact strength of such a solution is determined before use by titrating with a standard solution of ferrous ammonium sulphate employing ferroin as an indicator. The strength of the oxidising agent is also checked by titrating potentiometrically with a standard solution of hydroquinone.[1] 0·025 M solution of thiourea is prepared by dissolving 0·09515 g. of recrystallized thiourea in 50 ml. of glacial acetic acid.

0·025 M solution of hydroquinone is prepared by dissolving 0·1376 g. hydroquinone in 50 ml. glacial acetic acid or TBP-carbon tetrachloride mixed solvent.

An aliquot of thiourea solution ($10-70 \times 10^{-6}$ moles) is added to an excess of cerate ($60-200 \times 10^{-6}$ moles) taken in the potentiometric cell and diluted with glacial acetic acid to about 20 ml. The excess cerate is titrated back potentiometrically with hydroquinone, employing glass electrode-platinum electrode couple. A sharp fall in potential is noticed at the end point of the titration. The titre values are quite reproducible. The analytical results of a few representative experiments are given in Table I.

TABLE I

Oxidation of thiourea by ammonium hexanitrato cerate in tri-n-butyl phosphate

Sl. No.	Amount of thiourea taken moles $\times 10^6$	Total amount of cerate taken moles $\times 10^6$	Amount of cerate present in excess moles $\times 10^6$	Amount of cerate consumed moles $\times 10^6$	Per cent. error
1	16·75	87·00	70·25	16·75	0
2	61·43	121·80	60·70	61·10	−0·05
3	71·59	205·24	134·06	71·18	−0·05
4	22·34	69·60	47·05	22·55	+0·09

It is clear from the titre values given in the table that one mole of thiourea consumes one equivalent of the oxidant. The probable product of oxidation could be formamidine disulphide and the reaction may be represented as follows:

$$2S=C\begin{array}{c}NH_2\\NH_2\end{array} + 2\,(NH_4)_2\,Ce\,(NO_3)_6 \longrightarrow$$

$$\begin{array}{c}NH\\H_2N\end{array}C-S-S-C\begin{array}{c}NH_2\\NH\end{array} + 4NH_4NO_3 + 2HNO_3 + 2Ce\,(NO_3)_3$$

Similar observations have been made with other oxidising agents also. For instance, an aqueous solution of iodine oxidises thiourea to formamidine disulphide in acid medium and one equivalent of the oxidant is consumed per mole of thiourea reacted.[2] On the other hand, in alkaline medium the sulphur atom present in the thiourea molecule is converted into sulphuric acid and urea is the other product of oxidation by iodine.[3] Other oxidising agents such as potassium permanganate, hydrogen peroxide, potassium chlorate, sodium nitrite, ferric chloride and copper (II) salts are observed to oxidise thiourea to different oxidation products depending on the experimental conditions.[4-9]

Although a solution of ammonium hexanitrato cerate in acetonitrile oxidises thiourea it is found that the reaction does not exactly correspond to the formation of formamidine, as the oxidant consumed is always greater than one equivalent.[10] It is, therefore, not possible to make use of such a solution for the estimation of thiourea in non-aqueous solution. However, ammonium hexanitrato cerate in tri-n-butyl phosphate offers more accurate results and therefore it could be employed for the estimation of thiourea in non-aqueous media.

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STUDIES OF THE LATE QUATERNARY VEGETATIONAL HISTORY OF KUMAON HIMALAYA

VISHNU-MITTRE, H. P. GUPTA AND MRS. R. ROBERT

Birbal Sahni Institute of Palæobotany, Lucknow

THE late Quaternary vegetational history of the Kumaon Himalaya has been built up through the pollen-analytical investigations of the sediments from two lakes (Naukuchiya Tal and Bhim Tal) in the Naini Tal District. These lakes are situated in the subtropical region of the Outer Himalayas at an elevation between 1400–1500 m. The present-day vegetation consists

ARBOREAL POLLEN DIAGRAM FROM NAUKUCHHIYA TAL
(NAINITAL)
(PERCENTAGES CALCULATED IN TERMS OF A P)

FIG. 1

of Oak woods largely comprising *Quercus incana, Q. dilatata* and *Q. semecarpifolia* with Chir-pine (*Pinus roxburghii*) forming mixed or pure association.

The samples for pollen analysis were picked up at close interval from a bore-hole (one from each lake) made by a peat-auger. Of the two pollen diagrams the one from Naukuchiya Tal (profile six metres) yielded more or less a complete sequence. The Radio-carbon dates of critical horizons are not available as yet but from other grounds the pollen diagrams seem to slightly predate the Neolithic period and may as well extend down to the Mesolithic. For proper identification of subfossil pollen and spores, pollen morphology of 500 plant species distributed in Kumaon Himalaya was studied.

The pollen diagram brings out a succession between Chir-pine woods and the Oak woods. It has been possible to recognize four distinct vegetational phases from the Early Neolithic to the Recent times and these are designated by the alphabetical letters 'a', 'b', 'c' and 'd' as four stages (Fig. 1). During Stage 'a' the vegetation in the vicinity of these lakes largely consisted of Chir-pine with some sprinkling of Oak woods which probably occurred in pockets and depressions where moist and favourable conditions were available. The progressive invasion of the Oaks into the Chir-pine forest towards the top of Stage 'a' ultimately established the mixed-Oak woods during Stage 'b'. This changeover of the Chir-pine woods into the Oak woods seems to have been in response to a change in climate from dry to wet and humid. The formation of Oak woods was also accompanied by an overall increase in the other broad-leaved constituents. The Oak woods continued to be dominant during the Stages 'c' and

'd' although there were certain relative changes in the other broad-leaved elements. The appearance of pollen of some temperate plant species, such as Blue-pine (*Pinus wallichiana, Abies* and *Cedrus*) during Stage 'c' and its distinct increase during Stage 'd', suggests the downward shift of the temperate belt in response to the onset of cool climate. The pollen diagram seems to suggest a three-fold climatic sequence as recognized universally: Stage 'a' representing the period of increasing warmth, Stage 'b' representing the period of climatic optimum and Stages 'c' and 'd' representing the period of climatic deterioration.

The commencement of agriculture has been noted towards the close of Stage 'a', although charcoal evidence indicating the clearance of forest by fire is noted during the middle of Stage 'a'. It is not certain if the clearance of the forest by fire as indicated at this level was due to Man or natural causes. Plant economy during the lower half of Stage 'b' was moderate but during the upper half of Stage 'b' it decreased. During Stages 'c' and 'd' there are evidences of considerable increase in plant economy. It has not been possible to identify the crops grown during the past. Pollen of maize which can be easily identified has also not been met with in any of these stages.

In this region the Chir-pine constituted a widespread forest about 4000 to 5000 years ago. *Celtis australis* and *Ulmus* which were important constituents of the Oak woods during Stages 'b', 'c' and 'd' are almost absent from this region today. Similarly the genus *Salix* which was of much wider distribution in the past is now very much restricted in distribution, perhaps due to reclamation or natural drying up of lakes and swamps.

LETTERS TO THE EDITOR

CRYSTAL STRUCTURE OF 1:4 DIHYDROXYANTHRAQUINONE

PRELIMINARY data from X-ray diffraction by Chinizarin (Fig. 1) were reported by Murty (1959). The results were also identical from present measurements using Cu Kα radiation.

$$a = 20 \cdot 56 \text{ Å}$$
$$b = 6 \cdot 06 \text{ Å}$$
$$c = 10 \cdot 53 \text{ Å}$$
$$\beta = 125° \ 10'$$

Space group is uniquely centrosymmetric P2$_1$/a.

Number of molecules per unit cell is 4.

Structure analysis has been completed in the (010) projection.

FIG. 1

A (010) Patterson projection, origin removed and f sharpened, was made and the molecular centre to centre peak was easily identified from the following considerations. This peak was expected to be the strongest and also showed in a straight line with two other strong peaks (ring to ring interactions 23', 32' and 12', 21'). The vectors near the origin enabled the atomic co-ordinates to be readily fixed. Errors in a few structure amplitudes of low index reflections enabled the co-ordinates of the atoms in projection to be adjusted by inspection.

The structure was refined by difference synthesis till the R-factor fell to about 20% for only observed reflections.

Least squares refinement on IBM 1620 computer was first made only with observed reflections. Later all reflections were included. The R-factor at the end of the two cycles were 16·5% for observed reflections only; for all reflections in the copper sphere 35% when unobserved reflections were assigned zero amplitude; and 15% when to unobserved reflections threshold values were assigned.

The third y-co-ordinates of atoms were determined from inter-molecular contact distances and

bond lengths. The R-factor for hko observed reflections is 21%.

The overall isotropic temperature factor used in the calculations is 3·0 Å².

Table I gives the atomic co-ordinates.

TABLE I
Fractional atomic co-ordinates

Atoms	x	y*	z
C 1	0·042	0·351	0·217
C 2	0·041	0·189	0·133
C 3	0·102	0·155	0·109
C 4	0·165	0·336	0·175
C 5	0·163	0·495	0·260
C 6	0·104	0·536	0·289
C 7	0·229	0·299	0·149
C 8	0·295	0·493	0·223
C 9	0·293	0·636	0·311
C10	0·233	0·679	0·331
C11	0·354	0·457	0·192
C12	0·422	0·603	0·281
C13	0·420	0·799	0·356
C14	0·357	0·826	0·382
O 1	0·229	0·835	0·409
O 2	0·231	0·124	0·081
O 3	0·361	0·287	0·118
O 4	0·359	0·973	0·459

Three dimensional diffraction data are being collected.

Department of Physics,   S. SWAMINATHAN.
Indian Inst. of Technology,   G. D. NIGAM.
Madras-36, *July* 25, 1967.

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CRYSTAL DATA ON α-(PHENYLSULPHONYL)-CHALCONE

α-(PHENYLSULPHONYL)-CHALCONE (C$_{21}$H$_{26}$O$_3$S) was first obtained by Balasubramanian and Balaiah[1] in the form of colourless, platy crystals melting at 137–138° C. The authors have taken up the structure determination of this compound to determine which of the two possible configurations (Fig. 1) the molecule takes up. This communication presents the preliminary X-ray crystallographic data of the compound.

Analysis of rotation and Weissenberg photographs taken with Cu K$_\alpha$ ($\lambda = 1 \cdot 542$ Å) radiation showed that the crystal belongs to the Orthorhombic system with :

$$a = 18 \cdot 33 \text{ Å} ; \ b = 17 \cdot 13 \text{ Å} ; \ c = 12 \cdot 35 \text{ Å},$$

The density of the crystal is determined by the floatation method using calcium bromide solution. The observed value of $1 \cdot 07$ gm./c.c. is

FIG. 1

found to be in agreement with the value $1 \cdot 18$ gm./c.c. calculated for eight molecules per unit cell.

An examination of the *hko*, *okl*, *hol* and *hkl* reflections on Weissenberg photographs showed the following systematic absences :

　okl : *k* odd ; *hol* : *l* odd ; *hko* : *h* odd ;

　hoo : (*h* odd); *oko* : (*k* odd); *ool* : (*l* ood).

This uniquely determines the space group of the crystal as Pbca. Further study on the molecular structure of this compound is in progress.

The authors wish to thank Dr. K. V. Krishna Rao for his interest and Prof. V. Balaiah, Department of Chemistry, Annamalai University, for providing them with the sample used in this investigation.

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A NEW RADIOMETRIC STUDY OF THE SEPARATION AND ESTIMATION OF TRACES OF YTTRIUM

In recent years, a new technique—the radiometric analysis,[1,2] is becoming increasingly popular because of ease of manipulation, rapidity and accuracy of the method. This note reports the results of an investigation undertaken with a view to develop a new radiometric method of estimation of yttrium in traces.

The method, in brief, involves two steps : (*a*) quantitative precipitation of the trace element as its phosphate of known stoichiometry ; and (*b*) radiometric estimation of the amount of phosphorus removed as yttrium phosphate from the reaction mixture. Knowing the correct stoichiometric ratio, Y : P, in the precipitate and also the amount of phosphorus present in it, the quantity of yttrium is easily calculated.

To ensure quantitative precipitation of yttrium (its presence was checked by Y^{91} as the radioactive indicator), optimum experimental conditions were systematically worked out ; stoichiometric composition of the precipitate was also duly determined (1 Y : 1 P). The amount of phosphorus removed as the yttrium phosphate was estimated by measuring the radioactivity of a standard solution of potassium phosphate (tagged with P^{32}), before and after its reaction with the unknown sample of the trace metal. If A_0 and A are the counting rates of the solution, before and after precipitation and W is the quantity of phosphorus in it, the amount of phosphorus removed is given by $(A_0 - A)/A_0 \times W$.

In order to aid quantitative separation of the trace element from the mother liquor, silver thiocyanate produced in the reaction mixture containing excess of the thiocyanate ions was used as collector. From preliminary experiments, it was observed that under the specified conditions free phosphate ions are not removed except as the yttrium phosphate. It may be stated that for relatively large amounts of yttrium $(2 \times 10^3$ to $4 \times 10^2 \mu g.)$, quantitative separation of the phosphate can be effected by mere centrifugation even in the absence of the collector.

Spec. pure yttrium as nitrate (A.E.E.T.) was used as a standard for the trace element. Radioactivity was measured with the help of a liquid counter (20th century, U.K.) of the G-M type in conjunction with a Philips universal decatron scaler. All necessary corrections were applied to the gross counting rate. The probable error in counting was within $\pm$ 1%. An illustrative experiment is briefly described : To an aqueous mixture containing specified amounts of the nitrates of silver and yttrium is added, at room temperature, a mixed solution of ammonium thiocyanate and tagged phosphate. pH of the mixture is raised (pH between 6 to 7) by adding dilute ammonia and the total volume is made to 50 ml. The resulting mixture is stirred and allowed to stand for 90 min. The resulting suspension is then centrifuged and a measured volume of the supernatant mother liquor is then counted for radioactivity of the remaining phosphate. An exactly similar blank experiment in the absence of yttrium is conducted. From the two activity measurements, the amount of phosphorus in chemical combination with yttrium and hence the equivalent amount of yttrium is calculated.

The results (Table I) show that as small as 4 μg. of the element can be estimated with a fair degree of accuracy. A single estimation can be carried out in less than two hours. For lesser amounts of yttrium, high accuracy could not be achieved.

TABLE I
Estimation of Yttrium

Ag NCS Carrier in 50 ml. solution = 48·7 mg. ;   NCS⁻
ions added in excess = 5·0 mg. ;   pH of the
solution = 6·8 ;   Temp. = 25° C.

Yttrium			Yttrium		
Taken μg.	Found μg.	Error %	Taken μg.	Found μg.	Error %
393·70	386·04	−1·94	9·84	9·66	−1·82
303·70	388·25	−1·38	9·84	9·62	−2·23
98·42	97·26	−1·18	3·93	3·82	−2·70
98·42	97·50	−0·93	3·93	3·85	−2·00
49·21	48·77	−0·89			
49·21	48·18	−2·09			

Department of Chemistry,   K. R. KAR.
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INORGANIC CO-ORDINATION COMPLEXES OF O-AMINOPHENOL WITH SOME METALS OF 1st TRANSITION SERIES

Part III. Complexes of Zinc (II), Iron (III) and Vanadium (III)

O-AMINOPHENOL has been employed to prepare complexes with Zn [2], Fe^{+3} and V^{+3} and their structures have been resolved on the basis of analytical, conductivity, molecular weights and infra-red measurements.

All the three complexes were prepared by refluxing a solution of O-aminophenol and the corresponding metal salts in acetone for several hours. The semicrystalline complex, on being left overnight assumed a crystalline form. It was filtered, washed with acetone till free from the ligand, dried over P_2O_5 and analysed.

(*a*) *Bis (O-aminophenol) Zinc (II).*—Found Zn = 23·10%, C = 50·98%, H = 5·04%. N = 10·05% ; $C_{12}H_{14}N_2O_2$. Calculated, Zn = 23·06%, C = 50·79%, H = 4·99% ; and N = 9·88%.

(*b*) *Tris (O-aminophenol) Iron (III).*—Found Fe = 15·15%, C = 58·40%, H = 5·98%, N = 11·34% ; $C_{18}H_{21}N_3O_3$. Calculated Fe = 14·97%, C = 57·90%, H = 5·695% and N = 11·27%.

(*c*) *Tris (O-ominophenol) Vanadium (III).*—Found V = 13·58% ; C = 57·07%, H = 5·78%, N = 11·60% ; $C_{18}H_{21}N_3O_3$. Calculated V = 13·44%, C = 56·98%, H = 5·59% and N = 11·09%.

Zinc was estimated as ammonium phosphate and iron and vanadium as oxides. Carbon, hydrogen and nitrogen were estimated microanalytically. Conductivity values were determined in nitrobenzene at a concentration of 10^{-3} M. Molecular weights were obtained by the freezing point method in the same solvent. The solubility of the complexes is poor and hence a modified apparatus was used.[1] I.R. spectra were taken with nujol mulls on a Perkin-Elmer I.R. spectrophotometer, model 21, using sodium chloride prism.

Molar conductance of the complexes is very low (between 0·05–0·07 mhos) indicating that these behave as nonelectrolytes in nitrobenzene.[2] Determination of molecular weight gives the theoretical value, further confirming their non-electrolytic nature. It is thus clear that the ligand, besides being co-ordinated to the metals, through both the sites (NH$_2$ and OH), also neutralises their charges, suggesting the structures,

$$[M^{+2} (NH_2 . C_6H_5O)_2^-]^0 \text{ and } [M^{+3} (NH_2C_6H_5O)_3^-]^0.$$

The I.R. spectra shows only the NH stretching band in the vicinity of 3300 cm.$^{-1}$ The non-co-ordinated NH$_2$ group has the absorption band at 3400 cm.$^{-1}$ The negative shift in the position of the band is due to the co-ordination of the NH$_2$ group of the ligand to the metals. The band characteristic of the hydroxyl group which occurs at 3700 cm.$^{-1}$ in free O-amino-phenol is not observed in the spectra of the complexes, due to the ionization of the replace-

TABLE I

Name of compound	Molar conductance	Molecular Wt.		NH stretching frequency	Negative shift
		Obs.	Calc.		
1. Zn (O-aminophenol)$_2^0$	0·05 mhos	300·02	283·54	3265 cm.$^{-1}$	135 cm.$^{-1}$
2. Fe (O-aminophenol)$_3^0$	0·058 ,,	355·90	373·08	3282 cm.$^{-1}$	118 cm.$^{-1}$
3. V (O-aminophenol)$_3^0$	0·069 ,,	360·21	379·19	3262 cm.$^{-1}$	138 cm.$^{-1}$

able hydrogen and the co-ordination of the negative O⁻ with metals.

(MISS) PADMAJA REWA SHUKLA.

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COMPOSITION AND STABILITY OF METAL—4-(2-PYRIDYLAZO) RESORCINOL CHELATES OF VANADIUM, NIOBIUM AND TANTALUM

IN continuation of the previous work[1,2] reported from these laboratories on the chelates of 4-(2-pyridylazo) resorcinol (PAR), the chelates of vanadium, niobium and tantalum have been described. The compositions were found to be as 1 : 1 by employing the method of continuous variations and the mole ratio method, the V-PAR being studied at $550 \, m\mu$ (pH 5·0), Nb-PAR at $540 \, m\mu$ (pH 6·0) and Ta-PAR at $500 \, m\mu$ (pH 6·0). The absorption spectra of the complexes were studied by Vosburgh and Cooper's method[3] which indicated the λ_{max} at $550 \, m\mu$ for the vanadium, $540 \, m\mu$ for niobium and $500 \, m\mu$ for tantalum chelates. The λ_{max} of PAR was found to be $400 \, m\mu$ at pH 5·0 and $410 \, m\mu$ at pH 6·0.

The values of stability constants have been determined by different methods and are given in Table I.

TABLE I
Stability constants of chelates at 25° C.

Chelate	pH	log K	Method
V — PAR	5-0	4·2 ± 0·1	(i)
		5·2 ± 0·1	(ii)
		4·6 ± 0·1	(iii)
Nb — PAR	6·0	4·3 ± 0·1	(i)
		4·5 ± 0·2	(ii)
		4·7 ± 0·0	(iii)
Ta — PAR	6·0	4·5 ± 0·1	(i)
		4·7 ± 0·1	(ii)
		4·8 ± 0·1	(iii)

Methods (i), (ii) and (iii) correspond to the method of Dey and associates, Job's method of continuous variations and Mole ratio respectively.

A tentative suggestion for the structure of 1 : 1 chelates of vanadium, niobium and tantalum with PAR has been given on the evidence that the chelates are cationic as found by electrophoresis experiments. The structure proposed is

M stands for V, Nb and Ta

Chemical Labs., BADRI VISHAL AGARWALA.
Univ. of Allahabad, ARUN K. DEY.
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SOME NEW N-*p*-TOLYL-N′-2-(SUBSTITUTED) BENZOTHIAZOLYL GUANIDINES

CERTAIN substituted diguanides have shown antimalarial[1] activity which created interest in searching for other therapeutically useful members of this series and in due course led to the discovery of high antibacterial activity,[2] more commonly among a series of biguanides. Recently, Bhargava *et al.*[3-4] have synthesized several N-aryl-N′-2-benzothiazolyl guanidines and have shown that the hydrochlorides of these bases are more active against gram-positive bacteria as compared to gram-negative ones. This led the authors to synthesize some new diaryl guanidines in which one aryl group is *p*-tolyl and another a substituted benzothiazolyl group.

In this communication 2-amino-(substituted) benzothiazoles[5-7] were condensed with *p*-tolyl-isothiocyanate.[8] The resulting benzothiazolyl thiocarbamides[9] were desulphurized using lead oxide in ethanolic ammonia. The general method followed for preparing the guanidines is illustrated by the following example.

N-*p*-tolyl–N′-2-(4-chloro)–benzothiazolyl thio-carbamide (3 g.), yellow lead oxide (5 g.) and strong ethanolic ammonia (25 ml.) were heated in a sealed glass tube in a water-bath for 3–4 hours. Lead sulphide was filtered while hot and the N-*p*-tolyl–N′-2-(4-chloro)–benzothia-

TABLE I

N-p-Tolyl–N'–2–(substituted) benzothiazolyl guanidines

X—[benzothiazole ring]—C—NH—C—NH·C_6H_4·CH_3 (p)

with $=N$ on the ring, S at bottom, and $\|$ NH below the second C

Sl. No.	Nature of substituent X	Yield %	M.P. °C.	Mol. Formula	Nitrogen % Found	Nitrogen % Reqd.	Sulphur % Found	Sulphur % Reqd.
1	4-Chloro-	65	204	$C_{15}H_{13}N_4SCl$	17·54	17·69	10·15	10·11
2	5-Chloro-	70	196	$C_{15}H_{13}N_4SCl$	17·78	17·69	10·20	10·11
3	6-Chloro-	90	171	$C_{15}H_{13}N_4SCl$	17·65	17·69	10·04	10·11
4	6 Bromo-	60	159	$C_{15}H_{13}N_4SBr$	15·59	15·52	8·80	8·86
5	6-Methoxy-	35	162	$C_{16}H_{16}N_4SO$	17·93	17·95	10·19	10·25
6	4-Ethoxy-	45	188	$C_{17}H_{18}N_4SO$	17·30	17·18	9·76	9·81
7	6 Ethoxy-	40	160	$C_{17}H_{18}N_4SO$	17·25	17·18	9·93	9·81

zolyl guanidine obtained from the filtrate was crystallised from ethanol. The yields, melting points and analytical results, etc., of the various guanidines are given in Table I.

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College of Science,   R. Lakhan.
Banaras Hindu Univ.,
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DISTRIBUTION OF TITANIUM IN COEXISTING PYROXENES FROM THE KONDAPALLI CHARNOCKITES

The purpose of this note is to observe the nature of distribution of titanium in the coexisting (ortho- and clino-) pyroxenes from the charnockitic rocks of Kondapalli and Mardas, and to understand the causes for the observed distribution.

Eight Kondapalli pyroxene pairs were separated from their host rocks by following the usual techniques[1] and these purified mineral concentrates were chemically analyzed and their titanium content was determined colorimetrically. The data thus obtained, together with that available for ten Madras pyroxene pairs,[2-4] are presented in Table I. The weight

TABLE I

	Sample No.	Wt. % TiO_2 Ortho-pyroxene	Wt. % TiO_2 Clino-pyroxene
Kondapalli	323	0·27	0·69
	D14	0·43	0·43
	28	0·38	0·41
	61	0·26	0·48
	G17	0·24	0·35
	474	0·28	0·43
	62	0·38	0·40
	A18	0·30	0·43
Madras*	3709	0·10	0·68
	4645	0·15	0·72
Ch.	114	0·19	0·38
	2270	0·15	0·24
	2941	0·30	0·70
Ch.	132	0·20	0·32
Ch.	199	0·17	0·44
	4642 A	0·11	0·30
Ch.	207	0·14	0·25
	115	1·02	0·85

* Data from Howie,[2] Howie and Subramaniam,[3] and Subramaniam.[4]

per cent TiO_2 in orthopyroxene, chosen as a measure of concentration of the element, is plotted against the weight per cent TiO_2 in clinopyroxene on a graphical log-log plot (Fig. 1) for all these eighteen pyroxene pairs. Lines of equal distribution coefficient (K_D) have a 45° slope on such a plot and the line drawn represents $K_D = 1$. TiO_2 is more in clinopyroxene than in the coexisting orthopyroxene in seventeen pairs, while the reverse is observed in only one Madras pair; the distribution point

of the latter accordingly falls below the line whose $K_D = 1$ (Fig. 1).

FIG. 1. Distribution of TiO_2 between coexisting pyroxenes from Kondapalli (numbered circles) and Madras (triangles) charnockites.

It is noticed that the distribution points in Fig. 1 are scattered and that two distribution lines could be drawn (not shown) on the diagram to cover only six distribution points of the Kondapalli pairs; the scatter of the points representing the Madras pyroxene pairs is even more pronounced. If distribution coefficients are unaffected by compositional differences, then "equilibrium distributions will be reflected in clusters of points elongate parallel to the 45° lines, and non-equilibrium distributions will be reflected in scatter perpendicular to the 45° lines" (Albee[5]).

The observed haphazard distribution of TiO_2 in the coexisting pyroxenes is not wholly unexpected. The presence of Ti-bearing minerals occurring as lamellæ in some of the analyzed pyroxenes will not permit a serious discussion of the distributional relationship of the element; the distribution of the lamellæ in the host pyroxene grains is normally unequal and uneven and it is a common observation that the lamellæ are liberated from the host grains as the grain size of the latter is gradually reduced during the course of separation of the minerals. Hence the amount of Ti now present in the analyzed grains of purified pyroxene concentrates may not be the same as the amount present at the time of crystallization. Kretz[6] and Albee[5] have noticed that the elements Ti and Zr show the most erratic distribution in the coexistent phases, as the concentration of these elements are dependent on

the abundance of rutile, ilmenite and zircon inclusions in the minerals and the chance of contamination by these minor phase inclusions is too great in some cases.

It is to be emphasized here that the cause for the scattering of TiO_2 distribution points cannot be attributed to analytical error. At the same time one is led to believe that the irregular distribution of TiO_2 is not due to the failure of these minerals to establish an equilibrium with each other as the distribution of Fe^{+2} and Mg between the coexistent pyroxenes is regular and systematic.[7] Further, the probability that differences in temperature or pressure of crystallization were significant enough to cause the observed scatter is ruled out, as all the specimens were believed to have crystallized essentially at the same temperature and pressure.

Though it would be most desirable to explain the scattering of the distribution points as an effect of one or more other elements in the minerals, no definite and systematic correlation of this kind can be made at present from the available data.[7] But Kretz[8] suggested that the varying amounts of Al or Na in pyroxenes may change the affinity of these minerals for Ti and for this reason some scattering of TiO_2 distribution points is to be expected even if equilibrium was attained. It is only suggested here that the various causes which can account for the scattering of TiO_2 distribution points are : (1) the variable composition of the minerals ; (2) the presence of unequal amounts of Ti-bearing minerals occurring as lamellæ in the analyzed mineral grains ; (3) the nature and amounts of associated minerals including ilmenite ; and finally (4) the rock composition especially with reference to its enrichment or impoverishment of Ti. Due to these uncertainties and complications, TiO_2 figures seem to be invalid as a measure of distribution and the data will not permit us to assess the attainment of equilibrium (or otherwise) in the host rocks ; hence no meaningful purpose will be served by drawing any conclusions based on Ti distribution in the paired pyroxene phases.

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OCCURRENCE OF DINOSAURIAN REMAINS FROM THE LAMETA BEDS OF UMRER, NAGPUR DISTRICT, MAHARASHTRA*

THE present communication records the occurrence of a large number of dinosaurian remains, bones and coprolites, from the Lameta Beds exposed around Rajulwari (20° 54′ : 79° 17′) village near Umrer, Nagpur District, Maharashtra. The credit of noticing these fossils in this area goes to K. V. Lokras of the Geological Survey of India, while the actual recognition of the fauna is due to the present authors.

The Lameta Beds in this area mainly consist of variegated clays and are overlain by a thin layer of Deccan Trap. The dinosaurian remains are found at the surface, and although the coprolites are generally complete the bones are invariably broken, but both are well preserved. In other fossil localities, *viz.*, Akola (22° 55′ : 79° 19′), Pahmi (20° 45′ : 79° 29′) and Sirsapur

(20° 51′ : 79° 15′), in the Umrer area, the dinosaurian remains were found associated with freshwater molluscs, *Unio* and *Physa*, and a few chelonian remains. However, Rajulwari alone yielded the bulk of the dinosaurian material, a few of which are described here :

CF. *Titanosaurus indicus* LYDEKER[2]

(*i*) 9th *Caudal vertebra* (Fig. 1): Partly broken, laterally compressed, slightly curved, constricted in the middle.

(*ii*) 10th *Caudal vertebra* (Fig. 2): Partly broken, transversely narrow, compressed, lateral face-curved, centrum somewhat constricted in the middle ; articular faces for hæmopophyses fairly wide.

The dimensions of the two caudal vertebræ, described above, are as under :

	9th	10th
Length of the centrum without articular cone	10·0 cm.	10·0 cm.
Length of the centrum with articular cone	13·5 ,,	15·0 ,,
Proximal width of the centrum	8·0 ,,	9·0 ,,
Proximal height of the centrum in the middle	9·0 ,,	11·0 ,,

(*iii*) *Hind-limb* (Fig. 3): Besides the caudal vertebræ, one complete hind-limb, having a total preserved length of 210 cm., has been provisionally assembled from the skeletal remains of the sauropods collected from this locality. This hind-limb has been provisionally assigned to the genus, *Titanosaurus*. Detailed study is in progress.

FIGS. 1–6. Figs. 1–3. cf. *Titanosaurus indicus* Lyd. Fig. 1. 9th Caudal vertebra, ×1/5. Fig. 2. 10th Caudal vertebra, × 1/20. Fig. 3. Hind-limb, × 1/21. Figs. 4–6. cf. *Antarctosaurus* sp. Fig. 4. Anterior Caudal vertebra, (*a*) side view, × 1/5, (*b*) front view, × 1/4. Fig. 5, Rib, × 1/21, Fig. 6. Left humerus, × 1/6.

Cf. *Antarctosaurus* Sp.[2]

(*i*) *Anterior caudal vertebra* (Fig. 4): Slightly broken and distorted, probably 8th, anterior hæmopophyseal facets large and widely apart from each other, posterior facets partly preserved, lateral process on the left side below the neural arch coalesce with the anterior half of the centrum. The dimensions are:

Length of centrum with posterior cone	.. 22·0 cm.
Length of centrum without posterior cone	.. 15·0 ,,
Height of centrum in front	.. 14·0 ,,
Breadth of centrum in front	.. 12·5 ,,
Height of the whole vertebra in front	.. 22·0 ,,

(*ii*) *Ribs* (Fig. 5): A large number of broken pieces of ribs were found associated with other skeletal remains. None of them show the tuberculum or capitulum, and probably all pieces belong to the distal half of the ribs. Most of the fragments are flat and nearly straight and none show strong curvature. The transverse sections indicate different shapes from elliptical to plano-convex, the thicker edge of some specimens bear a groove. The width is fairly uniform upto 11 cm. from distal end and tapers more rapidly beyond this point. The total preserved length of a rib is 140·0 cm.

(*iii*) *Left Humerus* (Fig. 6): A broken head of a left humerus was also recovered from the same beds. It is convex on the posterior face and concave on the anterior and indicate the possibility of a slender shaft at the lower end (width 9·0 cm.). The preserved length of the specimen is 26·5 cm.

Age of the Fauna.—The fauna of the Lameta Beds from Umrer appears to be closely related to the fauna from Pisdura,[3,4] in view of the occurrence of *Titanosaurus* and *Antarctosaurus* in both the places. Von Huene and Matley[2] (1933) have assigned a lowest Senonian age to the Pisdura beds. Detailed study of the Umrer fauna, which is under progress, is likely to throw additional light on the age and faunistic relationship of these dinosaurs with those from other parts of India and the old Gondwanaland.

The authors are grateful to Shri M. S. Balasundaram, Director, G.S.I., for his keen interest in this work.

Palæontological Division,   K. N. Prasad.
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Southern Region,
Hyderabad-28, *June,* 28, 1967.

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TWO NEW FISH-LEECHES FROM PULICAT LAKE

Leeches infesting estuarine fish in India are known so far only from the Chilka lake, in the Orissa State.[1,2]

The present report deals with two species of brackish water leeches, *Zeylanicobdella arugamensis* de Silva, and *Pterobdella amara* Kaburaki, ectoparasitic on fishes from the Pulicat lake which is a large brackish water lake situated on the east coast of India, about 52 km. North of Madras.

Zeylanicobdella arugamensis de Silva, has been originally reported from Ceylon[3] and later the variety *radiata* of the same species, from off Singapore.[4] This species of leech is now collected in large numbers for the first time in India from the Pulicat lake, where it infests the Canine Catfish Eel, *Plotosus canius* Hamilton-Buchanan. Nearly 41 leeches have been obtained so far throughout the year, from about 9 specimens of the host caught from the shoal waters of the lake. The leeches were found attached to the chin and opercular regions of the host. They are small ranging from 3 mm. to 10 mm. in length and in live state are deep olive green in colour. Some of the leeches show radial bands on the posterior sucker, characteristic of the Singapore variety *radiata*. However, since the radial bands are faint and are not common to all individuals in this collection, it is considered that it might be a minor variation of not much taxonomic importance. In the Pulicat lake, this leech has been found to be host-specific to *Plotosus canius,* which is however a new host, recorded for this leech. So far as the records uptodate show, this leech seems to have a wide geographic and parasite-host distribution.

Pterobdella amara Kaburaki, another brackish water leech, is known only from the Chilka lake so far and is now collected for the first time from the Pulicat lake. About 29 of these leeches in live condition were recovered on the 11th March 1967, from the mouth region of the Sting Ray, *Trygon sephen* Forskal. The host, measuring 1400 mm. across the disc, was caught the previous night at the lake mouth and was landed ashore in the morning. It was dead by 12 Noon, but the leeches on it were still found to be alive. Compared to those from the Chilka lake, these specimens are larger measuring 15 to 20 mm. in total length. They are pale with pink streaks of pigment on the

abdomen dorsally. Kaburaki described the genus with its unique species, as lacking eyes, but these specimens from the Pulicat lake show a pair of crescent-shaped eye spots situated on the lower third of the anterior sucker dorsally.

Detailed studies on these two Piscicolid leeches are being worked out. I am indebted to the C.S.I.R. for the award of a Junior Research Fellowship. My thanks are due to Dr. P. J. Sanjeeva Raj for guidance and encouragement in this work.

Dept. of Zoology,   S. Jayadev Babu.
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RUPTURED GRAFFIAN FOLLICLE WITH HAEMORRHAGE

Cause of Death in Rabbits

It is a well-known fact that massive intraperitoneal hæmorrhage can occur from a ruptured graffian follicle in human beings. Taniguchy and Kilkenny[1] surveyed 74 cases and added ten of their own. Naidu *et al.*[2] recorded recently a similar observation. A bimanual examination, coitus or even a routine physical activity have been presumed to be the causes of rupture. Thrombocytopænia and anticoagulant therapy are also to be considered in the etiology. Probably, spontaneous hæmorrhage from the graffian follicle or corpus luteum occurs in animals also but not usually investigated into. The following autopsy note is of significance that way.

One morning a healthy female rabbit was found dead in the fen. The previous evening she took her feeds normally and was active as usual. Autopsy revealed a few millilitres of blood in the peritoneum. There was a big clot attached to the Right ovary (Fig. 1). All viscera were pale. Uterus tubes and the other ovary were normal, but pale. There were no other hæmorrhages. Sections from the right ovary from the area of attachment of the clot revealed a recent hæmorrhagic graffian follicle. So in this case probably, the cause of the death was shock due to rupture of the follicle with sudden hæmorrhage into the serous cavity. Actually the amount of blood lost is not much. As such, it is only a neurogenic shock process that should have been responsible for death than actually

any lowering of blood volume from absolute blood loss. How clotting has occurred in a serous cavity is difficult to explain. It may have to be postulated that the tissue damage and raw area at the ruptured follicle must have

FIG. 1. Right ovary shows attached clot. Left ovary normal.

induced clotting. The knowledge that such spontaneous hæmorrhage occurs in laboratory animals may help in learning more facts about pathogenesis of this type of lesion in the humans.

Dept. of Pathology,   D. Sundarasivarao.
S.V. Medical College,
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ON DETERMINATION OF ZOOPLANKTON VOLUMES

For determining the volume of zooplankton within the sample, different methods have been advocated by different authors (Ealey, 1954; Frolander 1957; Yentsch and Hebard, 1957; Tranter, 1960). During my present investigations on decapod larvæ of the Norwegian waters, I have found a modification of the apparatus recommended by Yentsch and Hebard (*loc. cit.*) handy for its simplicity and reasonable accuracy.

However, the accuracy of the method was observed to be hampered by the presence of

gelatinous matter (constituted by dismembered parts of jelly-fish) within the sample which gives an exaggerated value of zooplankton. Some of ctenophores and medusoid forms can be removed from the sample without difficulty. But these gelatinous substances are so transparent and slimy that it is difficult to detect and remove them completely. Besides, they also clog the mesh of the apparatus, affecting the speed of operation. Addition of a few drops of lactophenol to the sample before determining the volume has the desired effect of facilitating the removal of this gelatinous matter. It was observed that by adding a few drops of lactophenol, the gelatinous matter contracts and hardens, permitting its removal with a pair of forceps. During my present investigation, 10 to 15 drops of lactophenol were added to the sample (capacity of bottle 150 ml.) immediately after it was fixed with 5% neutralized formalin. The sample was processed in the laboratory about an hour after it was fixed. The decapod larvæ were preserved in ethylene glycol (diluted with equal volume of sea-water) as suggested by Williamson and Russell (1965) to preserve their colouration for identification.

The apparatus used here is made of perspex tube 130 mm. long with an internal diameter of 18 mm., one end of which is closed with bolting silk. The other end is provided with a cap carrying the volume indicator needle (fixed at 25 ml.) and two openings, one for introducing the nozzle of a burette and the other for displaced air to escape. Instead of using mercury, the tube is made watertight by screwing it down on to a rubber pad. The principle of operation of the apparatus is the same as given by Yentsch and Hebard (*loc. cit.*).

I record my thanks to the Norwegian Agency for International Development for award of Post-Doctoral Fellowship, to Prof. H. Brattström for working facilities, to Dr. D. I. Williamson (Port Erin) and Dr. C. S. Yentsch (Woods Hole) for going through the manuscript and offering suggestions. I also thank Dr. E. G. Silas for permission to outline the working of the apparatus.

Biological Station,   C. SANKARANKUTTY.
Espegrend, Blomsterdalen,
Norway, *May* 1, 1967.

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* Permanent address : National Institute of Oceanography, India.

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INTERACTION OF CCC AND COUMARIN OR IAA ON SEEDLING GROWTH OF RICE

THE recently discovered plant growth retardant CCC [(2-chloroethyl) trimethylammonium chloride] has an antiauxin effect on a variety of growth processes.[1,2] It also acts synergistically with auxin.[3] Coumarin is an inhibitor of seed germination[4] and root growth.[5,6] The inhibition of IAA (Indolyl-3-acetic acid) oxidation by coumarin has also been noted.[7] A recent report has emphasized the inhibition of lettuce seed germination by coumarin[8] or derivatives of auxin[9] and its reversal by derivatives of CCC. Because IAA[9] and coumarin[5,6,8] behave similarly in inhibiting root growth and CCC reverses this inhibition, the present work was initiated to elucidate if antagonism also exists between CCC and coumarin or IAA for the processes of root and shoot elongation in rice.

Healthy and uniform seeds of rice (*Oryza sativa*) variety MTU-17 were soaked for 48 hours in the test solutions after which the seeds were thoroughly washed and germinated on petri dishes impregnated with distilled water. There were four replications for each treatment. When the seedlings were four days old three seedlings were taken at random from each replication and the root and shoot lengths were measured to the nearest millmeter over a graph paper. The data were subjected to analysis of variance and the multiple range test[10] was used for determining significant differences among means.

IAA at $5 \cdot 71 \times 10^{-5}$ M had no effect in root elongation but the other concentration was inhibitory. Differential responses were observed so far as root and shoot (Table I) elongations were concerned. Coumarin was specific in inhibiting the root than the shoot elongation. At equimolar concentrations each of coumarin and IAA produced the same effect on shoot elongation but a quite different effect on root elongation. Coumarin in combination with either CCC or IAA exhibited the same quantitative response so far as shoot and root inhibitions were concerned. CCC + IAA was less inhibitory than the other combined treatments. It is apparent from the data that for the processes

<div align="center">TABLE I</div>

Interaction of CCC, Coumarin and IAA on the root and shoot elongation in rice. Each value is the mean of 12 seedlings ± standard deviation

Treatment			Length in centimeter after four days			
			Root	A	Shoot	A
Water (control)	..	..	$4 \cdot 7 \pm 1 \cdot 0$ *a*	..	$1 \cdot 9 \pm 0 \cdot 5$ *a*	..
CCC $(3 \cdot 16 \times 10^{-3}$ M)	..	..	$3 \cdot 6 \pm 1 \cdot 0$ *bc*	23	$1 \cdot 5 \pm 0 \cdot 6$ *bcd*	21
CCC $(3 \cdot 16 \times 10^{-4}$ M)	..	..	$4 \cdot 0 \pm 1 \cdot 0$ *b*	14	$1 \cdot 8 \pm 0 \cdot 4$ *ab*	7
Coumarin $(6 \cdot 84 \times 10^{-4}$ M)	..	..	$1 \cdot 9 \pm 0 \cdot 4$ *d*	60	$1 \cdot 4 \pm 0 \cdot 3$ *cde*	28
Coumarin $(6 \cdot 84 \times 10^{-5}$ M)	..	..	$3 \cdot 7 \pm 0 \cdot 8$ *bc*	22	$1 \cdot 6 \pm 0 \cdot 4$ *bc*	15
IAA $(5 \cdot 71 \times 10^{-4}$ M)	..	..	$3 \cdot 5 \pm 0 \cdot 7$ *c*	25	$1 \cdot 3 \pm 0 \cdot 4$ *def*	31
IAA $(5 \cdot 71 \times 10^{-5}$ M)	..	..	$4 \cdot 7 \pm 1 \cdot 1$ *a*	..	$1 \cdot 6 \pm 0 \cdot 6$ *bcd*	17
Coumarin $(6 \cdot 84 \times 10^{-4}$ M) + CCC $(3 \cdot 16 \times 10^{-3}$ M)	..	..	$2 \cdot 2 \pm 0 \cdot 7$ *d*	53	$1 \cdot 1 \pm 0 \cdot 3$ *f*	43
Coumarin $(6 \cdot 84 \times 10^{-4}$ M) + IAA $(5 \cdot 71 \times 10^{-4}$ M)	..	..	$2 \cdot 3 \pm 0 \cdot 8$ *d*	52	$1 \cdot 1 \pm 0 \cdot 3$ *f*	43
CCC $(3 \cdot 16 \times 10^{-3}$ M) + IAA $(5 \cdot 71 \times 10^{-4}$ M)	..	..	$3 \cdot 8 \pm 1 \cdot 1$ *bc*	19	$1 \cdot 2 \pm 0 \cdot 2$ *ef*	38

A = % reduction in length than the control;   *a*, *b*, *c*, *d*, *e* and *f* = values not followed by the same letter differ at 1% significance level.

of root elongation, CCC in combination with IAA was mutually antagonistic, a finding, which supports the statement[9] that the antiauxin specificity of CCC exists for root growth. The synergistic effect of CCC and IAA in inhibiting the shoot elongation also supports a previous report.[3] The significance of this investigation is that CCC may act as an auxin antagonist for the processes of root elongation and, on the other hand, as an auxin synergist for shoot elongation in rice plants.

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Department of Botany,   D. Mishra.
College of Agriculture,   S. C. Paul.*
Bhubaneswar-3, Orissa.
July 1, 1967.

* Present address: Central Rice Research Institute, Cuttack-6, Orissa.

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A NEW SPECIES OF *TYLENCHORHYNCHUS* (TYLENCHIDAE : NEMATODA) FROM MADRAS STATE, INDIA

TARJAN (1964) in his compendium of the genus *Tylenchorhynchus* recognised 69 species. Subsequently Sturhan (1966) has included 4 new species thereby increasing the total number of valid species known so far to seventy-three. Of these, 15 species are known to be prevalent in India (Khan *et al.*, 1964). Later Kumaraswamy *et al.* (1966) have recorded *Tylenchorhynchus curvus* Williams, 1960, from South India. Soil samples collected recently at Ootacamund (the Nilgiris District, Madras State) revealed the presence of yet another species, new to science, which is now designated as *Tylenchorhynchus nilgiriensis* n. sp. An intersex individual of this species was also found in the population collected. Hitherto only three cases of intersexuality have been reported among plant parasitic nematodes, in the two genera *Meloidogyne* and *Ditylenchus*, by Chitwood (1949), Hirschmann and Sasser (1955) and Triantaphyllou (1960). This is apparently therefore the first record of intersexuality in the genus *Tylenchorhynchus* and the fourth among the plant parasitic nematodes. The description of the new species is furnished below :

Tylenchorhynchus nilgiriensis n.sp.

Measurements.—14 ♀♀ —L : 0·64–0·79 mm. ; *a* : 28·5–36·8 ; *b* : 4·6–5·4 ; *c* : 14·2–17·0 ; V : [20-27] 53–57 [18-26].

Female (Holotype): L: 0·71 mm.; a: 30·2; b: 4·9; c: 15·0; V: ^{21} 56 ^{18} (Fig. 1, A, C, D).

Description.—*Female*: Body cylindrical, moderately arcuate, tapering at both ends. Body cuticle finely annulated, longitudinal striæ absent. Lateral field distinct, aerolated anteriorly, with five incisures, the middle line terminating at the phasmid. Phasmids conspicuous, opening slightly anterior to middle of the tail.

Lip region broadly rounded, set off from body by slight constriction, with 6–7 annules. Labial framework slightly sclerotised. Stylet 16·5 μ long, with posteriorly sloping basal knobs. Orifice of the dorsal œsophageal gland 2·0–2·5 μ behind stylet knobs. Median œsophageal bulb ovoid, well developed. Posterior œsophageal bulb with base somewhat flattened out and slightly overlapping intestine all around. Cardia inconspicuous. Excretory pore opens in between base of isthmus and posterior œsophageal bulb. Hemizonid one annule anterior to excretory pore. Nerve ring near middle of isthmus. Ovaries outstretched, oocytes in a single row. Spermathecæ not seen. Tail conoid, three times as long as anal body width, with smooth terminus and bearing 36–47 annules.

Male: Not known.

Intersex: L: 0·73 mm.; a: 33·2; b: 4·9; c: 14·5; V: $^{25}_{56}^{24}$. Body measurements do not differ from those of normal females. This individual possesses female reproductive organs as well as rudimentary male sexual characters. Spicules conspicuous and measuring 19 μ in length, gubernaculum 10 μ (Fig. 1, B).

Holotype.—Female collected December, 1966, Collection No. 174 of the Nematology Section, Agricultural College and Research Institute, Coimbatore, Madras State (India).

Paratypes.—14 females, same data as holotype.

Type host.—Collected from soil around roots of cabbage, *Brassica oleracea* var. *capitata.*

Type locality.—Ootacamund, Nilgiris District, Madras State (India).

Tylenchorhynchus nilgiriensis n. sp. can be distinguished from other species of the genus by the set-off lip region, posteriorly sloping basal knobs, five incisures and the large number of tail annules. It is perhaps most closely related to *Tylenchorhynchus acti* Hopper, 1959, *T. acutus* Allen, 1955, *T. capitatus* Allen, 1955, *T. curvus* Williams, 1960 and *T. goodeyi* Marinari, 1962, all of them having five lateral lines. From *T. acti*, it may be distinguished by the presence of posteriorly sloping basal

knobs, slight overlap of the posterior œsophageal glands, the smooth and tapering

FIG. 1. *Tylenchorhynchus nilgiriensis* n. sp. A. Adult female full length view. B. Intersex individual, posterior half. C. Adult female, head. D. Adult female, tail.

tail terminus (slightly enlarged or hemispherical in *acti*); from *T. acutus* by the stylet knobs and the number of tail annules (forwardly pointed stylet knobs and only 17 tail annules in *acutus*); from *T. capitatus* and *T. curvus* by the overlap of the glands and the nature of body annulation (only 32–33 tail annules in *capitatus*, coarse annulation with only 15–20 tail annules in *curvus*), and from *T. goodeyi* by the smooth tail terminus and shorter stylet (hemispherical annulated terminus and 20–24 μ long stylet in *goodeyi*).

Agricultral College and   A. R. SESHADRI.
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CYTOGENETICS OF A CRESCENT MUTANT OF RICE (*ORYZA SATIVA* L.)

IN the F_2 generation of a cross between two *indica* varieties Taichung Native I (TNI) and MTU 3, a mutant has appeared. The mutant is characterised by dark green, erect, narrow leaves with incurved margins and the crescent shape of the spikelets. From F_1 plants which were all normal 283 F_2 progeny plants were raised and out of these 25 plants (15 : 1 ?) showed the mutant traits (*viz.*, rolled leaf and crescent-shaped spikelets). These plants were numbered CR-1 to CR-25 and F_3 populations were raised from these individual plants.

TNI is a short growing *indica* type grown in Taiwan and it has been introduced into India recently for some of its desirable agronomic characters. The other parent MTU 3, is a locally cultivated strain which is fairly tall-growing with light green leaves. The F_1 hybrid is medium-statured, with dark green leaves and the length of the earhead is intermediate between the two parents. The mutant has narrow, dark green leaves with the margins rolled in. The spikelets are crescent-shaped and deeply incurved (both lemma and palea being involved) uniformly in all the mutant plants. The characters of the parents and the hybrids are given in Table I.

Cytological study of the F_1 plants and normal plants of F_2 generation showed a regular formation of 12 bivalents and normal meiosis. In the 25 mutant plants studied, an association of four chromosomes at diakinesis and metaphase I was observed. These are translocation heterozygotes. The different types of association of four chromosomes at diakinesis are given in Table II. The frequency of rings was more than chains. About 58·5% of cells were showing an association of four chromosomes at diakinesis and 43·5% at metaphase I. No univalents and trivalents were observed either at diakinesis or metaphase I. The mean chiasma frequency per cell at diakinesis was 22·5 and at metaphase I 21·82. The second meiotic

TABLE I
Characters of the parents, normal hybrid and the crescent mutant

Sl. No.	Characters	Parents		Hybrids	
		TNI	MTU 3	Normal F_1	Crescent mutant
1	Height of the plant (average) ..	70 cm.	125 cm.	100 cm.	100 cm.
2	No. of tillers per plant (average)	15–20	6–10	9–12	8–10
3	Leaf ..	Dark green, normal	Pale green, normal	Pale green to dark green, normal	Narrow, dark green, margins rolled in
4	No. of spikelets per earhead (average)	92	220	185	162
5	Shape of spikelets ..	Short, coarse	Medium, coarse	Medium, coarse	Curved markedly at the tip (crescent-shaped), medium

TABLE II
Frequency of different types of the association of four chromosomes at diakinesis in the crescent mutant

Crescent mutant plant No.	Types of association of four chromosomes							Total No. of cells observed
	○○	○	----	○‹	○--	∨	⊗	
CR-18 ..	69	14	6	4	2	..	4	99
CR-1 ..	8	4	2	..	..	..	4	16
CR-19 ..	5	6	3	2	1	3	..	20
Total ..	82	24	11	6	3	3	8	137

stages were normal. The high frequency of rings observed in cells with an association of four chromosomes and the alternate co-orientation of rings of 4 at metaphase I were all suggestive of the observed high pollen fertility (85·05%). The spikelet sterility (ovule abortion) ranged from 10% to 100% in the different mutant plants.

Backcrosses of the crescent mutant as female with its parents TNI and MTU 3 were unsuccessful perhaps due to incompatibility. However, the crosses with the crescent mutant as male have yielded a few seeds. The abnormal phenotypic characters rolled-leaf, and crescent-shaped spikelets were inherited as if they were a bloc. The plants bred true in F_3 for the mutant characters.

Andhra University,   A. V. S. S. Samba Murty.
Waltair,   J. V. Pantulu.
July 13, 1967.   M. B. V. Narasinga Rao.

FIGS. 1-2. Fig. 1. Photograph of the crescent mutant with narrow, erect inrolled leaves and the crescent-shaped spikelets. Fig. 2. Photomicrograph of a diakinesis cell showing the association of four chromosomes indicated by an arrow, and ten bivalents.

ANALYSIS OF THE KARYOTYPE OF *TURNERA ULMIFOLIA* LINN.

Ghosh (1960) working on the chromosome numbers of some dicotyledonous plants has reported the chromosome number of *Turnera ulmifolia* Linn., as $n = 15$ and $2n = 30$. He worked on material collected from Calcutta area. Raman and Kesavan (1964) isolated a wild population of *Turnera ulmifolia* var. *elegans* from Coimbatore area in South India and reported the somatic chromosome number as determined from leaf tip cells as $n = 10$ and $2n = 20$. Darlington and Wylie (1955) have not recorded the chromosome number of *Turnera*.

The present investigation was undertaken to make a detailed study of the somatic chromosomes of this taxon which is available in and around Bangalore (S. India). It has become wild in certain open and dry localities and flowers and fruits almost throughout the year. The capsules contain innumerable small seeds.

Seeds from mature capsules were germinated in petri-dishes under cold treatment. Young excised root tips were subjected to pretreatment with colchicine (0·05%) at room temperature and with 8-hydroxyquinoline (0·002 Mol.) at about 10° C. and squashed in 2% acetic orcein. Considerable difficulty was experienced in getting good preparations suitable for the study of the morphology of the somatic chromosomes. The chromosomes became either too much condensed or incompletely condensed. This difficulty was however overcome with certain modifications and control during pretreatment and staining.

The somatic chromosome number as determined from the root tip cells is found to be $2n = 30$ in this taxon. The somatic complement consists of relatively small chromosomes without marked difference in their lengths. It has

therefore a symmetrical karyotype which is considered to be a primitive feature.. The karyotype consists of fifteen pairs of chromosomes of which one pair has terminal satellites, eight pairs submedian constrictions and six pairs median constrictions. Figure 1 shows the thirty somatic chromosomes and Fig. 2 is the

FIG. 1. Somatic chromosomes, × 1,750.

FIG. 2. Idiogram of the somatic complement.

idiogram of the complement. The measurements of the chromosomes are given in Table I. The absolute length of the chromosomes is 51·50 microns. The presence of only one pair of nucleolar chromosomes is indicative of the diploid nature of this taxon.

TABLE I

Showing the measurements of the chromosomes of Turnera ulmifolia

Pairs	L.A. in μ	S.A. in μ	Total length in μ	Relative length	Index
1	1·65	0·66	2·31	8·97	0·40
2	1·48	0·50	1·98	7·69	0·33
3	0·99	0·99	1·98	7·69	1·00
4	0·99	0·99	1·98	7·69	1·00
5	1·32	0·57	1·89	7·34	0·43
6	1·07	0·82	1·89	7·34	0·76
7	0·99	0·82	1·81	7·03	0·82
8	0·90	0·66+0·16	1·72	6·68	0·91
9	0·90	0·82	1·72	6·68	0·91
10	0·90	0·74	1·64	6·37	0·82
11	0·82	0·82	1·64	6·36	1·00
12	0·82	0·58	1·40	5·34	0·70
13	0·66	0·66	1·32	5·12	1·00
14	0·66	0·58	1·24	4·82	0·87
15	0·82	0·41	1·23	4·78	0·50
Total ..			25·75μ	99·90	

The authors are thankful to Prof. M. Nagaraj for his interest in this work.

Department of Botany,   A. SHERIFF.
Bangalore University,   N. MAHALAKSHMI.
Central College,   A. K. ETHIRAJAN.
Bangalore, *July* 10, 1967.

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STOMATAL MOVEMENT IN RELATION TO DROUGHT RESISTANCE IN SUGARCANE*

LABORATORY and Field tests of plants, developed so far, for assessing drought resistance are based on the two important aspects of drought avoidance and drought tolerance. Among the factors concerned with drought avoidance, stomatal movement has been felt to be an important one. Soil moisture stress results in water deficits in the leaves and this induces stomatal movement depending on the magnitude of the deficit. According to Van den Honert[1] stomata at 50% of maximum opening and smaller should act effectively as transpiration regulators. Ehling and Gardner[2] observed that the dehydration of the leaf tends to close the stomata of most plants at a rather definite relative water content.

Preliminary investigations on the effect of soil moisture stress on stomatal movement and its possible relationship with drought resistance in sugarcane are reported in this note. Two genotypes differing widely in their drought resistant capacity were selected for the study, *viz.*, Badila (drought susceptible), a clone of *S. officinarum* and Co. 312 (drought resistant) a hybrid variety. Single-budded setts were planted in pots and when the plants were 4 months old, the drought treatment was given by withholding water. Leaf samples were fixed every day at 10 a.m. for a period of 10 days from the date of commencement of the treatment and epidermal peelings were taken following the procedure adopted by Singh and Varma.[3] The peelings were observed every day for stomatal closure. On the day the closure of the stomata was observed, the plants were rewatered and the recovery of the stomata noted.

In the drought susceptible variety, Badila, nearly 50% of the stomata closed completely on the ninth day from commencement of the treatment. On rewatering, none of them reopened even after 20 hours. On the other

hand, in the drought-resistant variety, Co. 312, all the stomata closed completely within seven days of commencement of the treatment and on rewatering all of them reopened within 20 hours. The closure of the stomata in the two varieties is illustrated in Figs. 1 to 4.

FIGS. 1–4. Fig 1. Co. 312. Normal water-stomata fully open. Fig 2. Co. 312, Drought-treated, stomata completely closed. Fig. 3. Badila, Normal water-stomata fully open. Fig. 4. Badila, Drought-treated, nearly 50% of stomata closed.

From the above observations, it is clear that the variety Co. 312, by closure of the stomata earlier than in the case of Badila, is in a position to effectively control loss of water by transpiration and hence is able to withstand soil moisture stress to a greater extent than Badila. Further, on rewatering, the photosynthetic rate and total assimilation rate of Co. 312 might be higher than in Badila, since all of its stomata opened earlier after withstanding the soil moisture stress unlike in Badila. The observations indicate the usefulness of such studies as one of the criteria for screening sugarcane varieties for drought resistance.

Our sincere thanks are due to Dr. R. D. Asana. Indian Agricutural Research Institute, New Delhi, for suggestions.

Sugarcane Breeding   K. M. NAIDU.
Institute,   K. V. BHAGYALAKSHMI.
Coimbatore,
July 13, 1967.

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CHROMOSOME BREAKAGE INDUCED BY HYDROLYTIC PRODUCTS OF THALIDOMIDE IN *VICIA FABA*

THALIDOMIDE, a synthetic drug, which was prescribed as a sedative to pregnant women during 1959-61 in several European countries, England and Canada, was responsible for the birth of thousands of severely malformed children (called thalidomide babies) in these countries (Taussig, 1962). Natarajan and Nilsson (1966) reported on the action of thalidomide and its products of hydrolysis on chromosomes of root meristems of *Vicia faba*. They found thaldomide by istelf to be ineffective in inducing chromosomal abnormalities but its hydrolytic products induced extensive shattering of chromosomes, chromosomes with gaps and chromosome breaks without rejoining. This communication supports the observation made by Natarajan and Nilsson on the chromosome breaking ability of the hydrolytic products of thalidomide.

Seeds of *Vicia faba* were germinated in sand beds and when the primary root was 2–3 cm. long its root meristem was cut and the root dipped in water in tubes to obtain secondary roots for treatment. A suspension of thalidomide (2 mg./ml.) in 10^{-2} M HCl was hydrolysed for 30 minutes at 60° C. The solution obtained was neutralized with 10% sodium bicarbonate and the secondary roots of *V. faba* were treated with this solution containing hydrolytic products of thalidomide for 5 hours, fixed in acetic alcohol, stained in feulgen and squashed for study. The types of aberrations obtained are given in Table I.

TABLE I

Aberrations induced by hydrolytic products of thalidomide

	Hydrolytic products	Control
Normal cells ..	48	128
Cells with shattered chromosomes ..	32	0
Cells with gaps ..	8	0
Number of breaks ..	49/23 Cells	0
Total cells scored ..	111	128

As seen from Table I the number of abnormal cells in the treated material is as high as 56%. The pattern of chromosome breakage resembles that produced by inhibitors of DNA synthesis like 5-fluorodeoxyuridine and aminopterin.

We are grateful to Dr. A. T. Natarajan for providing us a sample of thalidomide.

Division of Genetics,
Indian Agricultural
  Research Institute,
New Delhi-12, *July* 23, 1967.

DALMIR SINGH.
B. C. JOSHI.

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HANDLING IRRADIATED MATERIAL IN SEGREGATING GENERATIONS

IN mutation experiments, the frequency of induced mutations is usually expressed as the percentage of (1) M_1 Plant progeny, (2) M_1 spike progeny and (3) M_2 plants. In crops like barley, which produce fewer tillers, 5-6 on an average, usually the mutation frequency is expressed on spike-progeny basis. Many difficulties are encountered in high tillering crops like wheat and paddy, where the number of tillers is usually 8-10 or even more, to raise the M_2 generation on spike-progeny basis. However, in these crop plants there are 5-6 primary tillers which will have been differentiated much earlier in the ontogeny[3,6] (in the seed) and the rest are secondary tillers. In experiments where seed treatment is given, one should expect at least on theoretical grounds great differences in the mutation frequency between the primary and the secondary tillers.

In order to estimate the differences in mutation frequencies between main tillers and side tillers and also to find out the number of primary tillers which will have been affected at the initial treatment, an experiment was carried out in hexaploid wheat variety N.P. 870 treated with gamma rays with an acute dose of 20 Kr. In one experiment only the first formed tiller was separated and the rest of the tillers were bulked. In the second experiment, first four tillers were separated from the rest and the M_2 progenies were raised keeping the main tiller/s and side tiller progenies separately. Mutation frequency as measured by the percentage of visible (Chlorophyll and viable) mutation was worked out (Table I).

It is clear from the data given in Table I that in the first experiment where only one tiller was separated the frequency of mutations is more in side tiller progeny. Whereas in the second experiment where the first four primary tillers were separated, the mutation frequency is greater in the main tiller progeny.

Gaul[2] pointed out that mutation frequency expressed as the percentage of segregating families does not give a real estimate of the mutation rate and he suggested that it should be worked out as percentage of M_2 population.

TABLE I
Visible mutation frequency in M_2 generation
(Percentage of segregating progenies)

	One main tiller separated		Four main tillers separated	
	Main tiller progeny	Side tiller progeny	Main tiller progeny	Side tiller progeny
Chlorophyll	2·56	14·36	8·8	7·0
Viable	20·00	22·05	30·0	27·0
Total	22·56	36·41	38·0	34·0

In wheat there are 5-6 ear initials.[3,6] If one of the initials is affected we get the mutant individuals in the M_2 population.[1] Hence it appears convenient to calculate the mutation frequency on spike-progeny basis as it gives the real insight into the probable number of ear initials that were affected by the mutagenic treatment.

The relationship between mutations and tillers after seed irradiation has previously been investigated by several workers. In barley since the primordia of the tillers separate in the embryo at the time of treatment, a mutation occurring at this time affects only a single culm and then the mutant characters segregate in the progeny of a single head and is not present in the other heads of the same plant.[5] Therefore it seems likely that in mutation among heads of M_1 plants after seed irradiation the main stem and the lower primary tillers mutate independently while the mutation of the secondary and tertiary tillers derived from the primary ones may be dependent in cereals.

In the present experiment in the first case where only one main tiller was separated the mutation frequency was more in side tiller progeny. This could be expected as the side tiller progeny is the aggregate effect of 4-5 ear initials which were present at the time of original treatment. Hence this group has 4-5 times more possibilities for containing mutants in comparison with the single main tiller.[4] In the second case, where four primary tillers were separated the situation is quite reverse. The mutation frequency is more in main tiller progeny compared to the side tiller progeny. This is a clear evidence of the fact that the four primary tillers were present at the initial treatment and evidently they contained maximum mutations. It seems likely that the mutation frequency will be still higher if 5-6 first formed tillers are separated instead of only four, because usually 5-6 ear initials will have been differentiated in the embryonic seed.[3,6] The frequency of mutations in side tillers progeny in the second case appears to be slightly bloated

because this group still contain 1–2 primary tillers which were present when the treatment was given.

Hence it appears that separation of 5–6 primary tillers and raising the M_2 generation as M_1 spike progeny would be much more rewarding than growing M_1 plant progenies especially in crop like wheat.

I am thankful to Dr. M. S. Swaminathan, Director, I.A.R.I., New Delhi, for his interest and the C.S.I.R., for financial assistance.

University of Agri. Sciences,   J. V. GOUD.
Bangalore-24, *June* 20, 1967.

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THE GENUS *SCHUSTERIA* KACHROO–A COMMENT

IN my recently proposed new genus *Schusteria* (Kachroo, 1957) an unfortunate mistake had crept in with respect to underleaves. The latter are in fact *two per pair of lateral leaves* (*loc. cit.*, Fig. 4). *Schusteria* resembles in this respect *Diplasiolejeunea*, still differing from it in the restriction of gynœcia to short lateral branches and in lacking subinvolucral innovations.

Dr. Jovet-Ast. (1957, in lit.) appeared to doubt the validity of the character enumerated above and she cited (in support) Evans' (1912) figures for *Diplasiolejeunea pellucida* and *D. brachyclada*. Even though the excellent delimitation of the genus *Diplasiolejeunea* given by Spruce (1884–85), Evans (1912) and recently by Schuster (1956) leave little doubt with respect to innovations character it was still thought desirable to have a personal study of the above-mentioned species. On basis of this study the conclusions arrived at by Schuster, Evans, and Spruce are confirmed.

Incidentally, it may be recalled here that while describing the gynœcium of his subgenus *Lejeunea-Diplasiolejeunea*, Spruce (*loc. cit.*, p. 301) mentioned, "innovatione simplica proliferave suffulti". Evans (*loc. cit.*, pp. 212, 213, 216, 218, 220) clearly indicated the presence of an innovation which was further floriferous : often (*D. pellucida*) or rarely (*D. brachyclada*). Schuster (*loc. cit.*, p. 119) remarked, "innovation generally short, sterile or almost immediately fertile".

All these authors clearly indicated that the

gynœcia were never borne along the same side of the female shoots, as in *Schusteria*.

In *D. pellucida* (Meissn.) Schiffn—the type of *Diplasiolejeunea* the gynœcia are borne usually on leading shoots, commonly a single leaf and underleaf being the only vegetative leaves below the bracts and perianth ; and the gynœcia *invariably* subtended by an innovation which in most of the specimens studied is again, at least once, floriferous. However, in *D. brachyclada* the innovation is usually sterile. In *Schusteria* it was clearly stated that the *innovation is absent,* and that the *gynoecia are borne invariably on much abbreviated shoots,* the latter with a single leaf in addition to bracts.

(Late) Prof. Herzog (in lit.) in his criticism indicated that *Taxilejeunea tonduzana* Steph. (Figs. 1, 2), the species on which *Schusteria*

FIGS. 1–2. *Taxilejeunea tonduzana* Steph., aus "Tams' v Stepphanis. Fig. 1. Part of shoot with an underleaf and leaf, ventral view. Fig. 2. Perianth, ventral view, Both, × 50. "Perianthio medio constricta, medio infero obovato, supero late reniformi, plicia posteris .... late divergentibus, superne similibus ampliatis ...." (Figs. and description supplied by late Dr. Th. Herzog).

was presumably based, is a good *Taxilele jeunea*.[1] Possibly the packet examined by Kachroo was devoid of it. This has necessitated that a new specific name be affixed to the type of *Schusteria*. As such, it is proposed to rename *Schusteria tonduzana* Kachroo (nec *Taxilejeunea tonduzana* Steph.) as *Schusteria herzogii* sp. nov.

I am grateful to Prof. William C. Steere and Dr. Clark T. Rogerson (New York Bot. Garden) for loaning their entire collection of *Diplasiolejeunea pellucida* and *D. brachyclada* and to (Late) Prof. Th. Herzog for commenting on this note. To Prof. P. N. Mehra and Dr. R. M. Schuster, I record my thanks for their continued interest.

Indian Council of Agri. Res.,   P. KACHROO.
New Delhi, India, *August* 9, 1967.

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REVIEWS AND NOTICES OF BOOKS

Drugs Affecting the Peripheral Nervous System (*Medicinal Research Series*) (Vol. 1). By Alfred Burger. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1967. Pp. xxiii + 620. Price $ 27.50.

Reviews of neuropharmacological drugs have been written at various intervals, and from various points of view. A few individual subjects have been dealt with as chapters in monographs devoted to either the chemistry or the strictly biological and medical aspects of the drugs concerned. However, the whole field has not been considered before on a fundamental biochemical-pharmacological basis. This is the aim of the Medicinal Research Series.

Discussed in detail are the drugs acting on various parts of the nervous system, their mechanism of action, and their pharmacological individualites. Also included are such fundamental problems as the latest enquiries into the chemoreceptors of neurotransmittors, their artificial analogs, and their antagonists, and pharmacodynamic effects of these agents.

The titles of the chapters contained in this volume are : I. Molecular Aspects of Cholinergic Mechanisms, by S. Ehrenpreis ; 2. Postganglionic Parasympathetic Stimulants (Muscarinic Drugs, by Harris L. Friedman ; 3. Postganglionic Parasympathetic Depressants (Cholinolytic or Atropinelike Agents), by Joseph G. Cannon and J. P. Long ; 4. Ganglionic Stimulant and Depressant Agents, by Laszlo Gyermek ; 5. Drugs Acting at Nerve-Skeletal-Muscle Junctions, by J. J. Lewis and T. C. Muir ; 6. Reversible Inhibitors of Cholinesterase, by J. P. Long and C. J. Evans ; 7. Acid-Transferring Inhibitors of Acetylcholinesterase, by Irwin B. Wilson ; 8. Sympathomimetic (Adrenergic) Stimulants, by A. M. Lands and Theodore G. Brown, Jr. ; 9. Synthetic Postganglionic Sympathetic Depressants, by N. B. Chapman and James D. P. Graham ; 10. Effects of Drugs on the Afferent Nervous Systems, by Cedric M. Smith. C. V. R.

Science and the Educated Man. By Julius A. Stratton. (M.I.T. Press), 1967. Pp. ix + 186. Price 40 *sh.*

Addressed to the whole body of educated men, these speeches and talks from the decade 1956–1965 were originally prepared for delivery before administrators and managers, educators and students, scientists and engineers, and the general public ; indeed, their chief concern is with the intersection of the fields of activity of these once-divergent groups.

The book under review contains the following chapters : P(89 I—SCIENCE AND THE EDUCATED MAN : 1. Science and the Elucated Man ; 2. Into New Lands : The Principles of Navigation ; 3. The Role of the Engineer ; 4. The Purpose and Goals of M.I.T. ; 5. Abstract and Concrete ; 6. Personal Responsibility and an Informed Leadership ; 7. Physics and Engineering in a Free Society : A Viewpoint of Education ; 8. The Fabric of a Single Culture ; 9. Academic Freedom and Integrity ; 10. Science and the Process of Management ; 11. Learning and Action ; 12. A New Order of Responsibility ; 13. Individual Freedom and Personal Commitment ; 14. The Humanities in Professional Education. Part II— M.I.T. : INSTITUTIONAL AND PERSONAL EXPERIENCES : 15. A Technological University ; 16. The Realm of the Spirit ; 17. The Idea of a University ; 18. Charge to the Graduates ; 19. Three Men of M.I.T. ; 20. A Commitment to the Earth Sciences ; 21. Looking Back.

C. V. R.

Essays on Mathematics Education. By J. N. Kapur. (Ram Chand and Co., Ansari Road, Daryaganj, Delhi-6), 1966. Pp. 170. Price Rs. 10·00.

Mathematics education is of fundamental importance to the nation as crores of children all over the country study this subject. In this book, the author who is a distinguished mathematician gives his views on all aspects of mathematics education : school, under-graduate, post-graduate research. He discusses the present state of mathematics education and research and gives valuable suggestions for bringing about changes at all levels. The book will be of interest to all : to the parents, to the teachers of mathematics in schools and colleges, to the students of mathematics, to all educational administrators and to all educationists.

C. V. R.

Analysis of Straight-Line Data. By Forman S. Acton. (Dover Publications, 180, Varick Street, New York 14, New York), 1966. Pp. xiii + 267. Price $ 2.00.

This Dover edition, first published in 1966, is an unabridged republication, with minor corrections, of the work originally published by John Wiley and Sons, Inc., in 1959. . The contents of this book are : The Choice of a Model ; The Classical Model : x Known without Error ; Variance of y Constant ; Regression with Several Values of y for Each Known x ; Samples from Bivariate Normal Populations ; Regression with both x and y in Error ; Several Lines ; The Analysis of Variance ; The Exposure of Curvature : Orthogonal Polynomials ; The Use of Transformations ; The Rejection of Unwanted Data ; Cumulative Data ; The Fading Line. C. V. R.

Dover Publications, Inc., 180, Varick Street, New York :

1. **Ionospheric Radio Propagation.** By Kenneth Davies, Pp. xv + 470. Price $ 2.25.

This book, first published in 1966, is an unabridged and corrected republication of the work originally published in 1965 as National Bureau of Standards Monograph 80. The contents are given below : The Earth's Atmosphere, Geomagnetism, and the Sun ; Theory of Wave Propagation ; Synoptic Studies of the Ionosphere ; Oblique Propagation ; Signal Strength ; Ionospheric Disturbances ; Ionospheric Propagation Predictions ; Scatter Propagation on Very High Frequencies ; Propagation of Low and Very Low Frequency Waves. C. V. R.

2. **An Introduction to Abstract Algebra.** By Cyrus Colton Mac Duffee. Pp. vii + 303. Price $ 2.25.

This book, first published in 1966, is an unabridged and unaltered republication of the fifth (1956) printing of the work originally published by John Wiley and Sons, Inc., in 1940. The titles of the chapters contained in this book are as follows : The Theory of Numbers ; Finite Groups ; Algebraic Fields ; Integral Algebraic Domains ; Rings and Fields ; Perfect Fields ; Matrices ; Linear Associative Algebras. C. V. R.

The Harvey Lectures (Series 61). (Academic Press, New York), 1967. Pp. xiv + 269. Price $ 9.50.

The Harvey Society was founded in New York in 1905 with the object of the diffusion of scientific knowledge in selected chapters in anatomy, physiology, pathology, bacteriology, pharmacology, and physiological and pathological chemistry, through the medium of public lectures by men who are workers in the subjects presented.

The volume under review is the Sixty-First in the series and contains the nine monthly lectures delivered during the year 1965-66.

The article by Dorothy C. Hodgkin on crystallography, with emphasis on the structure of B_{12}, will interest not only medical men, but also chemists and crystallographers. Other articles in the volume include "Hypersensitivity to simple chemicals" by Merrill W. Chase, "Gene Structure and Protein Structure" by Charles Yanofsky, "Cerebral Fluids and Control of Breathing" by John R. Pappenheimer and "Biosynthesis of Hemoglobin" by Vernon M. Ingram. A. S. G.

An Introduction to Astrodynamics (2nd Edition). By R. M. L. Baker, Jr. and M. W. Makemson. (Academic Press, Inc., 111, Fifth Avenue, New York), 1967. Pp. xiii + 439. Price $ 11.75.

This second edition of *An Introduction to Astrodynamics* is a modification and extension of the first edition published in 1960. It includes new material on lunar and meteoritic background, co-ordinate systems and astrodynamic constants. A few pages are also devoted to the discussion of anomalous luminous phenomena and unidentified flying objects (UFO) such as flying saucers, ball lighting, etc. Several new exercises have been added.

The object of the authors is to provide a textbook which will be a prerequisite to the more advanced volumes on Astrodynamics and its applications. Thus the emphasis in the treatment is upon practical application rather than elaborate mathematical proofs. A. S. G.

Trace Characterization—Chemical and Physical. Editors : W. Wayne Meinke and Bourdon F. Scribner. National Bureau of Standards Monograph 100. Pp. 580. Price $ 4.50. (Order from the Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402).

A **Symposium on Materials Research** was held in the new NBS Institute of Materials Research Laboratories at Gaithersburg, Maryland, in October 3–7, 1966. Over 600 scientists

representing industry, government and university from the U.S. and from many other countries attended. The volume contains the invited papers presented at the symposium, together with summaries of the contributed papers and ensuing discussions by the rapporteurs.

It is now well known that high-purity materials show unique properties, and even the slightest changes in their trace impurity contents profoundly modify the properties exhibited. Semiconductors are the most conspicuous examples, and in fact, it was the demands of semiconductor technology that stimulated the initial development in the detection and analysis of "traces"—be they chemical contaminants or physical defects—in solids.

To give some examples : The electrical properties of germanium and silicon are markedly changed by the introduction of as little as 10 ppba (parts per billion atomic) of copper into the former or 2 ppba of gold into the latter. Ordinary tungsten is quite brittle but when it is purified to a level below 10 ppm it becomes readily machineable. The ductility of beryllium increases by a factor of 40 when impurities therein are reduced to a few ppm. The superconducting transition temperature of molybdenum is degraded from $0 \cdot 9^\circ$ K. to $0 \cdot 3^\circ$ K. by introducing 100 ppm of iron. In the recrystallization of lead, the grain boundary velocity is reduced by a factor of 1000 by a few ppm of silver. The efficiency of graphite in a nuclear reactor is markedly reduced by the presence therein of only 2 ppm of boron. The magnetic permeability of iron is increased from a few 1000 to a few 100,000 when its carbon, sulphur, nitrogen and oxygen contents are reduced from a few hundred ppm to a few dozen ppm. And lastly the maser and the laser provide examples where the crystalline environment of the trace impurity is essential to the functioning of the device.

The above examples will give an idea of the importance of trace analysis and trace characterization of materials in modern science and technology. It is not enough to know what atoms are present and in what amount, but also to know *where* they are present and *how* they are present. Research leading to the effective utilization of potentially important materials thus require full information on characteriza-

tion of traces and structural imperfections so that consistent reproduction of results regarding the desirable properties may be obtained.

The NBS symposium of papers is intended to present candid reports on the present status of efforts in trace characterization by the various methods that are now available, evaluating their successes as well as their limitations. The topics covered include trace characterization and properties of materials; electrical measurements ; electrochemical methods ; optical and X-ray spectroscopy ; X-ray diffraction ; optical methods ; chemical spectroscopy ; nuclear methods ; mass spectroscopy ; preconcentration ; sampling and reagents ; electron and optical microscopy.

This is a timely publication, offered at a modest price, to serve as a guide book on the subject in materials research laboratories.

A. S. G.

Experimental Techniques in Physical Metallurgy. By V. T. Cherepin and A. K. Mallik. (Asia Publishing House, Calicut Street, Ballard Estate, Bombay), 1967. Pp. 428. Price Rs. 30·00.

This is a thorough book on the subject of the title, and may be expected to receive popular demand from students. It exactly fulfils the needs of a student in practical physical metallurgy. The authors deal in detail with experimental techniques relating to high temperature and vacuum, microscopic examination, electron metallography, general methods relating to metals and alloys coming under thermal, electrical, dilatometric and magnetic measurements. A chapter is devoted to elasticity and anelasticity measurements. Although intended primarily for students of metallurgy, the book is sure to appeal to a wider audience concerned with experimental physics. A. S. G.

Books Received

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ABSOLUTE CONFIGURATION OF SELINIDIN, VAGINIDIN AND RELATED COMPOUNDS

T. R. SESHADRI AND M. S. SOOD*

Department of Chemistry, University of Delhi, Delhi-7

IN recent publications on the chemical components of *Selinum vaginatum*,[1] the isolation and structure elucidation of selinidin and vaginidin were reported. In this communication their absolute configurations are discussed.

Selinidin belongs to a group of naturally occurring coumarins which have 2′, 2′-dimethyl-dihydropyranocoumarin (I) as their basic skeleton. Soine[2] in his review on *"Naturally occurring coumarins and their physiological activities"* listed five coumarins (II-VI) which have this skeleton with acyloxy substituents at 3′ and 4′-positions; recently many more of this type have been reported (VII-XII).[3-6] All these coumarins (II-XII) give a mixture of *cis*

chart 1

(I)

(XIII) *cis*

R & r

SEE TABLE

(II) — (XII)

cis

feature. The stereochemical relationship between the natural coumarins and *cis* methylkhellactone is based on optical rotation and IR spectra.

(+) *Cis* methylkhellactone which is the reference compound has been shown to have the 3′(S) and 4′(S) configuration. Compounds (II-X) have been discussed by Nielsen et al.[3,4] and they have all been assigned this configuration at these two positions. Since the others (XI-XII) also give the same reaction and have similar properties they also should be considered to have the same configuration.

Selinidin is a monosubstituted derivative with the single substitution at 3′ (XIV). On hydrolysis it gives angelic (tiglic) acid and a hydroxy-coumarin (XV) found to be identical with lomatin, recently isolated from *Lomatinum nuttallii* by Soine et al.[7] and hence selinidin has been assigned the structure of 3′-angelyloxy-2′, 2′-dimethyldihydropyranocoumarin. The absolute configuration of selinidin at 3′ will therefore be the same as that of lomatin and this is discussed below.

Lomatin has earlier been subjected to catalytic hydrogenation[1,7] to yield dihydrolomatin (XVI) which is identical in all respects with a product

(II-XII) R and R′

No.	Name	R	R′
II	Samidin	—COCH=C(CH₃)₂	—COCH₃
III	Dihydrosamidin	—COCH₂CH(CH₃)₂	,,
IV	Visnadin	—COCH(CH₃)CH(CH₃)₂	,,
V	Suksdorfin	—COCH₃	—COCH₂CH(CH₃)₂
VI	Pteryxin	,,	—COC(CH₃)=CHCH₃
VII	,,	—COCH=C(CH₃)₂	—COCH=C(CH₃)₂
VIII	,,	—COCH₃	,,
IX	Isopteryxin	—COC(CH₃)=CHCH₃	—COCH₃
X	Calipteryxin	,,	—COCH=C(CH₃)₂
XI	Anomalin	,,	—COC(CH₃)=CHCH₃
XII	Peuformosin	—COCH=C(CH₃)₂	,,

and *trans* methylkhellactones (XIII) when boiled with methanolic hydrochloric acid or methanolic alkali. The formation of the *trans* compound in this reaction has been attributed to easy epimerization at the benzylic 4′-position of the original *cis* compound; the easy methylation of this position is another characteristic

obtained under similar conditions from *cis* methylkhellactone which undergoes, besides reduction of the coumarin double bond, the loss of the benzylic methoxyl also. Since this catalytic hydrogenation does not affect the asymmetric centre at 3′, the absolute configuration at this position of lomatin and *cis* methylkhellactone should be the same. Hence lomatin can be assigned the structure of 3′(S)-hydroxy-2′, 2′-dimethyldihydropyranocoumarin;

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* Present address: The Royal Danish School of Pharmacy, Copenhagen, Denmark.

selinidin being the 3'-angelyl ester of lomatin, should also therefore have 3'(S) configuration.

chart 2

(XIV) R = — COC=CH—CH₃ (with CH₃ below)
(XV) R = H

(XV) → (XVI) ← (XIII)

(XVI)

Vaginidin (XXXI) on catalytic hydrogenation has been recently reported[1] to yield (+)

chart 3

(XVII) (XXVIII) (XXIX)

R & R' SEE TABLE

(XVIII) – (XXVII) cis

(XXX)

tetrahydro-oroselol *iso*valerate (XXXII) which on alkaline hydrolysis yielded (+) tetrahydro-oroselol found to be identical in all respects

(*XVIII–XXVII*), R and R'

No.	Name	R	R'
XVIII	Peulustrin	CH₂OCOC(CH₃)=CH—CH₃ —COC—C(CH₃)₂ OH H	H
XIX	Isopeulustrin	,,	H
XX	Columbianadin Oxide	— O —	H
XXI	Archangelicin	—COC(CH₃)=CH(CH₃)	—OCOC(CH₃)=CH(CH₃)
XXII	Libanotin	,,	—OCOCH₃
XXIII	Columbianetin	H	H
XXIV	Columbianin	Glucose	H
XXV	Columbianadin	—COC(CH₃)=CHCH₃	H
XXVI	Athamantin	—COCH₂CH(CH₃)₂	—OCOCH₂CH(CH₃)₂
XXVII	Edultin	—COCH₃	—OCO(CH₃)=CH(CH₃)

Vaginidin, the second coumarin from *S. vaginatum* belongs to another class having 2'-hydroxyisopropyl - 3' - hydroxydihydrofuranocoumarin (XVII) as basic skeleton. Recently the presence of many such coumarins (XVIII-XXII)[9-12] has been reported in addition to those earlier listed (XXIII-XXVII) by Soine.[2] Vaginidin resembles archangelicin (XXI), athamantin (XXVI) and edultin (XXVII) very closely. On the basis of the configurational study of Nielsen *et al.*,[13] coumarins that give (+) tetrahydro-oroselol (XXVIII) when subjected to catalytic hydrogenation followed by hydrolysis, have 2'(S) configuration. The conclusion was based on the fact that (+) tetrahydro-oroselol can be obtained from (+) dihydro-oroselol (XXIX) which has been assigned 2'(S) configuration based on its degradation to (+) tubaic acid hydrate (XXX). In agreement with Schmid and co-workers,[14] Nielsen *et al.*[13] have suggested S configuration at 3' for athamantin and archangelicin. Recently Nakazaki *et al.*[15] made similar observations and proposed 2'(S) and 3'(S) configuration for both athamantin and edultin.

with a product obtained earlier from athamantin[14] by similar reaction. Based on the general conclusions given above tetrahydro-oreselol *iso*valerate and vaginidin should have (S) configuration at the 2'-position. In view of the structural resemblance of vaginidin to athamantin, archangelicin and others, it should have the *cis* structure in 2',3'-positions. This conclusion is supported by the splitting pattern (doublet, J = 7 cps) of the protons attached to these two positions in the NMR spectra of vaginidin and other related compounds; hence the absolute configuration of vaginidin should be 2'(S) and 3'(S).

chart 4

(XXXI) (XXXII) → (XXVIII)

R = COCH₂—CH(CH₃)(CH₃)

The above conclusions regarding the absolute configuration of the naturally occurring dihydro-pyrano- and furano-coumarins seem to have important significance in regard to their biogenesis. Aneja et al.[16] discussed the possible origin of the *isoprenyl* unit attached to the coumarin system and its transformations into various furan derivatives. It would appear that the dimethylallyl coumarin (XXXIII) is the nearest precursor to the above-mentioned groups and undergoes *cis*-hydroxylation at the double bond of the side chain giving the 'S' configuration for the asymmetric centre at the 2'-position. This diol (XXXIV) can cyclize in two different ways resulting in the formation of dihydropyrano- or furano-compounds. In the first case the resulting 2', 2'-dimethyl dihydro-pyrano derivative (XXXV) will have 'S' configuration at its 3'-position. Alternatively, the cyclisation can take place at the asymmetric carbon atom of (XXXIV) when the dihydrofuran derivatives (XXXVI) with 'S' configuration at 2'-position will be formed. In some compounds mentioned above there are two hydroxyls which would suggest the operation of stereospecific oxidation at the benzylic positions as shown in Chart V. The oxidative cyclisation of XXIII to angelicin has already been discussed.[16]

chart 6

(XXXVII)

chart 5

(XXXIII)

(XXXIV)

(XXXVI)

ANGELICIN

(XXXV)

In the above-mentioned coumarins, it is significant that a number of C-5 acids are involved in the esterification of the hydroxyl groups. It is possible that all of them arise from the same precursor. The isoprenyl residue coming from mevalonic acid (XXXVII) by decarboxylation and other changes, can get oxidised to give $\beta\beta$-dimethylacrylic acid which can undergo transformation to give rise to various other acids as indicated.

Recently[17] by using the tracer technique angelic acid has been shown to arise from *iso*-leucine (XXXVIII) instead of from mevalonic acid. Hence it is possible that C-5 acids arise

from different sources including amino-acids. Another possibility could be visualised that angelic acid may arise in certain cases from substituted succinic acids (XXXIX) derived from the Krebs cycle.[18]

chart 7

(XXXVIII)

(XXXIX)

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RADIOCARBON DATES OF SOME PREHISTORIC AND PLEISTOCENE SAMPLES

D. P. AGRAWAL AND SHEELA KUSUMGAR

Tata Institute of Fundamental Research, Bombay-5

TODATE, most of our C^{14}-datings have referred to sites that are younger than 5000 B.P. A beginning is now made towards evolving a chronology of stone-age cultures and of Pleistocene events. Present paper includes samples from prehistoric sites as also from geologic deposits. Wherever the Pleistocene deposits were implementiferous, mention has been made in the sample description. The "chemical" and "counting" procedures adopted in making the radiocarbon measurements have been reported earlier (Kusumgar *et al.*, 1963; Agrawal *et al.*, 1965) in detail.

[All samples were first manually cleaned to remove extraneous matter including rootlets. Dilute HCl (1%) was used to dissolve any soluble soil carbonates present in the samples. Charcoal with bigger and harder lumps alone was given NaOH pretreatment, lest it disintegrated, for removal of humic acid, if present. Samples were converted into pure methane and counted in gas proportional counters. Ninety-five per cent. activity of N.B.S. oxalic acid is taken as the 1950 reference standard.

For each sample two dates are given: first is based on the C^{14} half-life of 5568 years; the second, within parenthesis, is based on the value of 5730 years. All dates are expressed in years B.P., for conversion to A.D./B.C. scale 1950 A.D. should be used as reference year (Godwin, 1962).]

GENERAL COMMENTS

Terdal, a neolithic site, has been dated to ca. 1800 B.C. and shows its contemporaneity to Tekklakota (Nagaraja Rao, 1965) and other allied sites. For the first time the microlithic cultures of Adamgarh and Lekhahia rock-shelters have been dated. Mula dam samples seem to show that Indian middle stone-age is younger than about 35,000 years.

For dating prehistoric cultures the problem of collecting datable samples is quite difficult. Charcoal is rare in stone-age deposits. Bones are available sometimes, but unless charred, their inorganic fractions have a high propensity to get contaminated by ground water carbonates. Collagen, the organic fraction of bones, is a more reliable material (Berger, 1964; Krueger, 1965) but it is difficult to extract it in sufficient quantities. The sampling techniques of palæo-

botanists may prove more useful for these early deposits.

Present paper includes a few early Holocene and upper Pleistocene samples from Kerala Coast, Godavari Delta, Mula river deposits and Kathmandu valley. Several institutions[*] are currently engaged in studying this period from various angles. The Radiocarbon Laboratory is actively collaborating with them to evolve an absolute chronology for the late Pleistocene period. We hope that radiocarbon dating would provide a valuable linking factor in the correlation of eustatic sea-level changes and time sequences of terraces (Zeuner, 1964) of thalasso-static, periglacial, climatic and glacifluvial origins.

C^{14} DATES WITH SAMPLE DESCRIPTIONS

Adamgarh, Madhya Pradesh, India

Adamgarh (Lat. 22° 43' N., Long. 77° 44' E.), District Hoshangabad, is a microlithic site with rock-shelters. It was excavated by R. V. Joshi and M. D. Khare. Sample submitted by A. Ghosh, Director-General of Archæology, New Delhi-11.

TF-116, Rock Shelter, 2765 ± 105
(2845 ± 105)

Uncharred bones from Trench ADG-2, Layer 3, Depth 1·90 m., Field No. II. Comment: only inorganic fraction dated, hence probability of contamination high.

TF-120, Rock Shelter, 7240 ± 125
(7450 ± 130)

Shells from Trench ADG-10, Layer 2, Depth 0·15 to 0·21 m., Field No. X. Comment: sample from pre-chalcolithic microlithic phase.

General comment: Dating of collagen (organic fraction) from some more bone samples from Adamgarh can alone confirm the chronology of this mesolithic culture.

Chavara-Kayankulam, Kerala Coast, India

Chavara-Kayankulam Coast (Lat. 8° 49' N., Long. 76° 30' E.), Kerala. Sample submitted by G. Prabhakar Rao, Atomic Minerals Division, Department of Atomic Energy, Shardhanandpeth, Nagpur-3.

TF-203, Borehole No. 20, 5470 ± 115
(5610 ± 115)

Molluscan shells from off-shore borehole No. 20, Depth 1·8 to 3·6 m., Field No. CKO/1.

TF-204, Borehole No. 21, 6120 ± 110
(6295 ± 115)

Molluscan shells from off-shore borehole No. 21, Depth 3·9 to 5·2 m., Field No. CKO/2.

Dum-Dum, India

TF-443, Dum-Dum area, 6000 ± 120
(6175 ± 125)

Wood, *Heretiera* sp., from Dum-Dum near Calcutta, District 24 Parganas. Sample No. 4(a), Field No. IV. Palæobotanical sample submitted by A. K. Ghosh, Botany Department, Calcutta. NaOH pretreatment was also given.

Godavari Delta, India

TF-612, Godavari Delta core, 10815 ± 155
(11130 ± 160)

Shells from a core from Godavari Delta (Lat. 16° 59′ N., Long. 82° 45′ E.), Depth 117 m. Sample submitted by Dr. Aswathanarayan of Andhra University, Waltair. Comment: the sample will date the upper age limits of the marine facies of the recent Godavari delta.

Har Raipur, India.

TF-611, Har Raipur, terrace, 4070 ± 95
(4190 ± 95)

Elephant tusk from Har Raipur, Field No. HRP. F-1 from a river terrace. Sample submitted by G. C. Mohapatra, Chandigarh. Comment: inorganic fraction of bone alone could be dated; contamination probability is high. Organic fraction recovered was not sufficient.

Lekhahia, Uttar Pradesh, India

Lekhahia (Lat. 24° 80′ 5″ N., Long. 82° 32′ E.), District Mirzapur. The site is being excavated by G. R. Sharma who submitted the samples.

TF-343, TF-341, TF-342, TF-344—all charcoal samples gave modern ages. Samples seem to be heavily mixed up with modern charcoal. The excavator informs that these rock shelters have been used by shepherds to light fires till modern times. All of the samples derive from layer 1 levels only. As the site was important four samples were measured, but to no avail.

TF-417, Rock Shelter, 3560 ± 105
(3660 ± 110)

Bones from Rock Shelter I, Skeleton No. VI, Locus 5-7, Layer 4, Depth 15 cm.

Mula Dam, Maharashtra, India

Mula Dam (Lat. 20° 21′ N., Long. 74° 37′ E.), District Ahmednagar. Samples submitted by H. D. Sankalia, Deccan College, Poona, India. Samples were exposed during dam construction operations.

TF-345, Pleistocene deposits,

$$31075 {+5550 \atop -3245} \left(31980 {+5715 \atop -3340}\right)$$

Wood from "Pleistocene deposits" at R.L. 1640 from old bed of Mula river, Sample No. 2. NaOH pretreatment was also given. Comment: From the uppermost alluvium few middle stone-age and late stone-age tools have been recovered. Error given with data is 2 standard deviations.

TF-217, Pleistocene deposits, > 39,000

Wood from "Pleistocene deposits" at R.L. 1645 from old bed of Mula river, Sample No. 1. NaOH pretreatment was also given. Comment: no tools are reported from these deposits.

Sankhu, Nepal

TF-189, Pleistocene deposits,

$$29115 {+3220 \atop -2285} \left(29960 {+3315 \atop -2350}\right)$$

Peat sample from naturally exposed road-cutting on way to Sankhu (Lat. 27° 43′ N., Long. 80° 25′ E.), near Kathmandu, Stratum Upper peat-bed. Visible rootlets were handpicked. Sample submitted by A. Ghosh.

Terdal, Mysore, India

Terdal (Lat. 15° 59′ 30″ N., Long 75° 5′ E.), District Bijapur, first site excavated in West in the Krishna Valley by Dr. H. D. Sankalia who has submitted the sample.

TF-683, Neolitric, 3615 ± 120
(3720 ± 120)

Charcoal from Trench-1, Layer 3, Depth 45-65 cm., Field No. 40.

TF-684, Neolithic, 3775 ± 95
(3885 ± 100)

Charcoal from Trench-1, Layer 2, Depth 17-25 cm., Field No. 28.

Warkala, Kerala, India

Warkala (Lat. 8° 44′ N., Long. 76° 42′ 20″ E.), coast has been subject of many geologic investigations. Charred wood dated here was part of Warkala formation of Kerala Coast. Samples submitted by G. Prabhakar Rao.

TF-201, Warkala formations, > 45,000

Charred wood from Warkala formations, embedded ca. 0·3 m., in compact clay, Field No. WK/1.

TF-202, Warkala formations, > 40,000

Charred wood from Warkala formations, embedded ca. 0·3 m., in compact clay, Field No. WK/2. NaOH pretreatment was also given.

Comment: Dating of these formations has a bearing on the possibility or otherwise of oil-bearing strata in the region and on causes of the present-day coastal erosion. Samples will date emergence of the Kerala Coast also.

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MODIFICATION OF ALUMINIUM-SILICON ALLOYS BY MISCH METAL ADDITIONS

R. SHARAN* AND T. R. ANANTHARAMAN

Department of Metallurgy, Banaras Hindu University, Varanasi-5

THE modification of aluminium-silicon alloys by additions of small percentages of a few selected elements, particularly sodium, has been investigated by several workers[1-4] recently. The present work was planned to explore the possible role of misch metal, primarily as modifier and secondarily as beneficial alloying addition, in improving the quality of hyper-eutectic aluminium-silicon alloys. Earlier work[5] in our laboratory has already established the beneficial role of misch metal in refining the structure of Al-Cu and Al-Mg alloys.

Commercial aluminium of 99·5% purity and silicon of 99·0% purity were used in the present investigations. The misch metal contained 50–52% cerium, 20–22% lanthanum, 15–17% neodymium and 10-12% of other rare earth elements. This mixture of metals was preferred to one or more of the pure metals because of its low cost and easy availability, particularly in our country. A systematic study has been completed of the effects of this addition on the microstructure and mechanical properties at room and elevated temperature, both in the sand-cast and metal mould-cast conditions.

An aluminium—13% silicon alloy was first prepared. In each experiment, a sample of the alloy was melted in an induction furnace and held at 800° C. The required amount of misch metal wrapped in aluminium foil was plunged into the molten bath, agitated mildly and the casting made at 700° C. in a cast iron

or sand mould, as desired. Routine mechanical testing methods were employed.

The results (Figs. 1–7) display the following salient features:

1. Misch metal additions seem to modify the structure appreciably in both sand-cast and metal mould-cast conditions (Figs. 1-6). There is little effect upto 0·5% addition (Fig. 2), but complete modification is obtained at about 1·0% addition (Figs. 3 and 6). With further additions, recoarsening of the eutectic takes place and some new phase makes its appearance in the microstructure (Fig. 6).

2. Tensile strength and percentage elongation at room temperature increase upto about 1·0% addition of misch metal and then decrease in both sand and metal mould-cast alloys (Fig. 7). The tensile strength of the alloy with 1·0% misch metal is 5 tons/sq. inch higher than the tensile strength of the sodium-modified alloy cast under the same condition.

3. Hardness also increases upto about 1·0% addition of misch metal, but remains almost constant upto 2·0% (Fig. 7). Further additions lead to a steady increase in hardness.

4. As at room temperature, tensile strength was found to increase appreciably at 200° C. upto about 1·0% misch metal addition and then to decrease. At 400° C. the tensile strength was found to remain almost unchanged with misch metal additions.

Kim and Heine[1] have developed a growth temperature critical shape hypothesis for modification in Al-Si alloys. Their experiments indicate that the phase shape assumed by silicon

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* Present Address: Department of Metallurgical Engineering, Roorkee University. Roorkee.

(polyhedral, coarse or fine plates in the normal eutectic and globular in the modified eutectic), is dependent on growth temperature. The polyhedral silicon or silicon plates in normal alloys are produced by the habit characteristics of the higher temperature of formation. The modifying element does not directly cause the globular shape in the modified eutectic, but

FIGS 1-6. Figs. 1-4. Microstructures of Al-13% Si alloy-sand-cast and etched with Keller's Reagent, × 100. Fig. 1. Without any modification. Fig. 2. With 0·5% Misch Metal addition. Fig. 3. With 1·0% Misch Metal addition. Fig. 4. With 4·0% Misch Metal addition. Figs. 5-6. Microstructures of Al-13% Si alloy-cast iron mould-cast and etched with Keller's Reagent, × 100. Fig. 5. Without any modification. Fig. 6. With 1·0% Misch Metal addition.

lowers the nucleation temperature to less than 500° C. where the globular shape grows naturally. According to them, the modifying element should have a tendency to form compounds with the precipitating phase at a temperature below the normal eutectic temperature. Further, the modifying element should have a low compound-forming tendency, low solubility and possibly a miscibility gap with the solvent phase.

Our experiments confirm that the unmodified microstructure consists of polyhedral silicon and coarse silicon plates (Figs. 1 and 5). With increasing misch metal addition, coarse silicon plates are converted first into fine plates and finally into globular ones with about 1·0% addition (Figs. 2, 3 and 6). The microstructure of the alloy treated with 1·0% misch metal consists of only the primary solid solution and globular fine silicon eutectic. If the temperature dependence of the silicon phase shape is valid, it easily follows that misch metal depresses the nucleation temperature of silicon. Small additions do not seem to be effective and depression to the temperature of globular growth is possible only with about 1·0% addition. Cerium is reported to dissolve upto 0·05% by weight in aluminium in the solid state, while lanthanum is reported to have no solid solubility in aluminium.[6] Thus very little of the cerium-lanthanum content of the misch metal goes into solid solution; most of it reacts with aluminium to form intermetallic compounds like Al_4Ce and Al_4La. The cerium and lanthanum may also react with the precipitating silicon phase to form compounds[7] like Ce_3Si, Ce_2Si, $CeSi$ and $LaSi_2$. Thus the chief metals present in misch metal satisfy the requirements of a modifying element as laid down by Kim and Heine[1] except that these elements have also the tendency to react with the solvent phase to form intermetallic compounds. A higher percentage of misch metal than sodium is needed for modification possibly because of the tendency of the modifying addition to react with the solvent phase, thus inhibiting formation of stable silicon compounds. The nucleation temperature of silicon is depressed to the temperature of globular growth only with larger additions of misch metal when sufficient amount of modifying element is present to react with the silicon phase also. The presence of the primary alpha phase in these hyper-eutectic alloys can also be explained as by Kim and Heine.[1]

The gradual increase in hardness beyond 2·0% addition may be understood as due to the formation of fine particles of intermetallic compounds. The increase in tensile strength may

FIG. 7. Effect of Misch Metal additions on the Mechanical Properties of Al-13% Si alloy at room temperature.

be partly attributed to the modification and partly to the strengthening effect produced by the fine dispersion of harder intermetallic compounds like Al_4Ce and Al_4La, unlike in the sodium-modified alloy where the increase is attributed only to the modification of the structure. This also explains why a higher value of tensile strength has been recorded for the alloy treated with misch metal. The improvement in high-temperature tensile strength may also be due to these fine particles. The decrease in the tensile strength at room temperature beyond 1·0% addition may be due partly to the relatively increased amounts of intermetallic compounds and partly to the recoarsening of the matrix. The exact nature of the insoluble phases could not be confirmed in the present metallographic studies.

Hodge and Smith[8] have indicated that misch metal affects the surface tension and reduces the oxide film. Supporting evidence from contact angles and interfacial energies has, however, been ignored by Kim and Heine.[1]

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LETTERS TO THE EDITOR

CRYSTALLOGRAPHIC DATA ON A FOUR CO-ORDINATED DIPHENYL SULPHOXIDE COMPLEX OF Cu^{2+}

DIPHENYL sulphoxide, $(C_6H_5)_2SO$, forms a variety of co-ordination compounds with different metal ions. The structure of diphenyl sulphoxide (DPSO) has been solved,[1] but no crystallographic data on its complexes are so far available. Recently, Gopalakrishnan and Patel[2] have synthesized and characterised a number of metal-DPSO perchlorate complexes with general formula $M(DPSO)_n(ClO_4)_2$, where $M = Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}$ or Cd^{2+} and n is the number of DPSO molecules co-ordinating to the metal ion. However, in this series, the copper compound is of particular interest in that the number of co-ordinating DPSO groups in this case is four whereas in all the other compounds this number is six. Hence, $Cu(DPSO)_4(ClO_4)_2$ was taken up for X-ray analysis. The electron paramagnetic resonance study of this compound has already been carried out in this department.[3]

Green prismatic crystals of $Cu(DPSO)_4(ClO_4)_2$, elongated along the a-axis were grown by slow evaporation of a solution in acetone. The unit cell dimensions were determined from oscillation and Weissenberg photographs taken about the crystallographic a-axis using $CuK\alpha$ radiation. The X-ray diffraction pattern did not possess any symmetry and no systematic absences of reflections were found in the photographs. Hence the crystals were assigned to the triclinic system. The density of the sample was measured by flotation in a mixture of carbon tetrachloride and benzene. The crystal and physical data of the compound are as follows:

Space group: $P1$ or $P\bar{1}$

$a = 9\cdot04 \pm 0\cdot02$ Å	$\alpha = 90° \ 8' \pm 1°$
$b = 16\cdot49 \pm 0\cdot02$ Å	$\beta = 90° \ 44' \pm 1°$
$c = 16\cdot04 \pm 0\cdot02$ Å	$\gamma = 95° \ 43' \pm 1°$

Volume of the unit cell $= 2379\cdot13$ Å³
Formula weight $= 1071\cdot52$
Number of formula weights
  in the unit cell $= 2$
Measured density $= 1\cdot511$ gm./c.c.
Calculated density $= 1\cdot496$ gm./c.c.
Absorption coefficient
  for X-rays ($= 1\cdot5418$ Å) $= 37\cdot95$ cm.$^{-1}$

The multiplicity of general position in space groups $P1$ and $P\bar{1}$ are onefold and twofold respectively. Hence, as there are two $Cu(DPSO)_4(ClO_4)_2$ units in the elementary cell, all the atoms should occupy general positions in either case.

The author is grateful to Prof. R. S. Krishnan for his kind interest and to Dr. M. Vijayan for suggesting the problem. Her thanks are also due to Mr. J. Gopalakrishnan and Dr. C. C. Patel of the Department of Inorganic and Physical Chemistry of this Institute for the supply of the material used in this investigation.

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ROTATIONAL ANALYSIS OF TWO BANDS OF $A^2\Pi \to X^2\Sigma^+$ SYSTEM OF THE MgCl MOLECULE

THE spectrum of MgCl molecule has been studied previously by Walter and Barratt[1] (1928), Parker[2] (1935) and Morgan[3] (1936) in absorption. A single system of four-headed bands, lying in the region 3950–3600 Å and degrading toward the shorter wavelength, has been observed. The detailed vibrational analysis of the bands by Morgan has shown that they arise due to a transition $A^2\Pi \to X^2\Sigma^+$ with a doublet interval of 55 cm.$^{-1}$ amongst its $^2\Pi$ components.

This system has been studied for the first time in emission using a high frequency oscillatory discharge. The bands have been photographed in the sixth order of a 2-meter plane grating spectrograph with a dispersion of 0·56Å/mm. The rotational analysis of (0, 0) and (0, 1) bands of the sub-system $^2\Pi_\frac{1}{2} \to {}^2\Sigma^+$ has been carried out and the rotational constants have been determined. The constants obtained in the present analysis are given in Table I.

The bands reveal the presence of well resolved P_{12} and Q_1 branches and an overlapping R_{12} branch with Q_1 branch lines. Near the P_{12} head of the (0, 0) band weak unresolved heads

TABLE I

*Molecular constants of the upper and lower
states of MgCl molecule*

Upper State	Lower State
$B_0' = 0\cdot2186$ cm.$^{-1}$	$B_0'' = 0\cdot2146$ cm.$^{-1}$
$D_0' = 1\cdot7 \times 10^{-7}$ cm.$^{-7}$	$D_0'' = 1\cdot7 \times 10^{-7}$ cm.$^{-1}$
$r_0' = 2\cdot33 \times 10^{-5}$ cm.	$r_0'' = 2\cdot35 \times 10^{-8}$ cm
$I_0' = 127\cdot99 \times 10^{-40}$ gm. cm.^{2}	$I_0'' = 130\cdot38 \times 10^{-31}$ gm. cm.^{2}

corresponding to P_1 and PQ_{12} were observed.
The analysis has revealed that the bands arise
due to an electronic transition of the type
$A^2\Pi \rightarrow X^2\Sigma^-$.

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AROMATICITIES OF PENTAFLUOROBENZENES

THE possibility of estimation of aromaticity
from dilution shifts of aromatic protons in inert
solvents was first suggested by Kanekar *et al.*[1]
Kanekar and Khetrapal[2] later extended the
method for the estimation of aromaticity of
compounds which need not contain protons; in
this method the compound under study is dis-
solved in benzene or cyclohexane and the dilu-
tion shift $(\triangle\delta)$ of the solvent protons is esti-
mated; the dilution shift of the same protons
in CCl$_4$ $(\triangle\delta')$ is then estimated and the quantity
$\triangle\delta - \triangle\delta'$ thus obtained is directly proportional
to aromaticity and inversely to the molar volume
(V_m) of the compound under study. Using this
method, aromaticities of several pentafluoro-
benzenes have been estimated and the results
are reported in this communication. It may be
pointed out that no other method has so far
been used to find out the aromaticity of these
compounds. The model method as proposed by
Elvidge and Jackman[3] is not practicable for
these compounds as suitable models are not
available.

The compounds studied were obtained from
M/s. Imperial Smelting Corporation Ltd. Analar
grade CCl$_4$, C$_6$H$_6$ and C$_6$H$_{12}$ were used as
solvents and the spectra were recorded on a
Varian high resolution NMR spectrometer
operating at $56\cdot445$ Mc/s. Solutions of these
compounds were made both in benzene and
cyclohexane and the chemical shifts of the
solvent protons were estimated relative to dio-
xane as external standard. Bulk diamagnetic
susceptibility correction was applied to the
measured shifts. The shifts at each concentra-
tion expressed relative to the pure solvent were
plotted against the mole fraction of the solvent
and the curves were extrapolated to infinite
dilution in order to estimate $(\triangle\delta)$. $(\triangle\delta')$ was
similarly estimated for benzene and cyclohexane
in CCl$_4$. The values of $|\triangle\delta - \triangle\delta'|$ in C$_6$H$_6$ as
well as in C$_6$H$_{12}$ along with V_m and values of
aromaticity, A in percentage relative to benzene,
are given in Table I for several pentafluoro-
benzenes.

TABLE I

$(\triangle\delta - \triangle\delta')$, V_m and A values for pentafluoro-
benzenes

Compound	$(\triangle\delta - \triangle\delta')$ ppm.			V_m	A % relative to C$_6$H$_6$
	In C$_6$H$_6$	In C$_6$H$_{12}$	Mean		
Pentafluorobenzonitrile	0·45	0·45	0·45	126	89
Octafluorotoluene	0·49	0·48	0·48	144	108
Iodopentafluorobenzene	0·30	0·34	0·32	135·6	68
Pentafluorobenzene	0·41	0·47	0·44	113	78
Pentafluorobromobenzene	0·38	0·35	0·37	129 3	74
Pentafluorotoluene	0·42	0·37	0·40	128·3	80
Pentafluorothiophenol	0·38	0·43	0·41	127·2	81
Pentafluoroanisole	0·18	0·18	0·18	135·3	38
Hexafluorobenzene	0·49	0·45	0·47	119·6	88

The value of A relative to C$_6$F$_6$ for pentafluoroben-
zene estimated from the dilution shift of the ring pro-
ton in CCl$_4$ is 84% which is in agreement with that
reported in column (6).

It is seen that the values of A are related to
σR values of the substituents, *e.g.,* the sub-
stituents such as CF$_3$, CN with positive σR
values increase the aromaticity value compared
to the parent compound. This has also been
observed earlier for benzaldehyde and benzyl
chloride by Kanekar *et al.*[4] Moreover in
halogens the A values change in the order
I < Br < F. On this basis the value of A for
pentafluorochlorobenzene is expected to lie
between that for the corresponding bromo and
fluorocompound.

Pentafluoroanisole behaves in an anamolous
way since it gives very low value of A. The
reason for the anamoly is not clear.

It is a great pleasure to thank Dr. C. R.
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LITHIUM ALUMINIUM HYDRIDE REDUCTION OF 1-(α-NAPHTHYL)-2-NITROCYCLOHEXENE

It has been shown that 1-aryl-2-nitrocyclo-hexenes, on lithium aluminium hydride reduction, yield the geometrically pure *cis*-2-arylcyclo-hexylamines as the major product.[1,2] 1-(α-naph-thyl)-2-nitrocyclohexene, on such reduction, gives the *cis*-2-(α-naphthyl)-cyclohexylamine (A) in about 90% yield. In addition to this product, a neutral compound (B), m.p. 204° C, of formula $C_{16}H_{17}NO$ [Found C, 80·7%, H, 6·9%, $C_{16}H_{17}NO$ requires C, 80·35%, H, 7·1% and ν_{max} (KBr) 1650 cm.$^{-1}$ (C = N) and 3268 cm.$^{-1}$ (–OH)] is obtained. This minor product is shown to be 1-(α-naphthyl)-2-oximinocyclo-hexane.

An authentic sample of 1-(α-naphthyl)-2-oximinocyclohexane, m.p. 204° C. [Found C, 80·4%, H, 7·5%, $C_{16}H_{17}NO$ requires C, 80·35%, H, 7·1% and ν_{max} (KBr) 1650 cm.$^{-1}$ (C = N) and 3268 cm.$^{-1}$ (–OH)] was prepared by the oximation of 2-(α-naphthyl)-cyclohe-xanone which was synthesised through a Grignard reaction of α-naphthyl magnesium bromide and 2-chloro-cyclohexanone according to the method of Hussey *et al.*[3] The mixed melting point of this oxime with the compound (B) above showed no depression. The I.R. spectra of this oxime and that of (B) were identical.

The $\alpha\beta$ unsaturated nitro compounds of the open chain type on lithium aluminium hydride reduction are shown to give the corresponding hydroxylamines and oximes in addition to the amines.[4] The reduction of the title compound either by normal addition of lithium aluminium hydride or by the reverse addition gave the two products, the amine (A) and the oxime (B). When the lithium aluminium hydride—1-(α-naphthyl)-2-nitrocyclohexene complex is decomposed with cold water some amount of ammonia is definitely evolved towards the

final stages of the decomposition. Presumably a small amount of 1-(α-naphthyl)-2-imi-nocyclohexane is formed in the reduction which might hydrolyse to give ammonia. This is in keeping with the suggestion of Gillsdorf and Nord.[5] The oxime formation of the title compound to the amine cannot be an intermediate step in the reduction since the amine isolated is a geometrically pure *cis* compound.[2] The oxime formation may be through a simultaneous independent reduction.

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PARAMAGNETIC RESONANCE IN GAMMA-IRRADIATED RONGALITE

PARAMAGNETIC resonance techniques have been employed for detecting the presence of odd electron species in gamma-irradiated alkali thio-sulphates,[1,2] and sodium dithionite[3] and tentative suggestions have been made for the formation of SO_2^- ion in these compounds under gamma irradiation. Rongalite or sodium formaldehyde sulphoxylate is a stable addition compound of sodium sulphoxylate and formaldehyde and recently, Rinker *et al.*[4] have shown the presence of SO_2^- ion in acidified solutions of rongalite, by e.s.r. spectroscopy. It was thought to be of interest to expose micro crystalline rongalite to Co^{60} gamma radiation and compare the e.s.r. spectrum of the irradiated compound with those of the alkali thiosulphates and sodium dithionite.

Sodium formaldehyde sulphoxylate $NaHSO_2$. $HCHO.2H_2O$ (May and Baker sample) was used for irradiation after purification by repeated re-crystallization from aqueous solution. The compound was sealed in pyrex tubes in presence of air and was irradiated in a 1000 curie 220 gamma-cell, to a total absorbed dose of 2.53×10^{20} ev per gm. The dose rate was determined with a Fricke dosimeter. The e.s.r spectrum of gamma-irradiated rongalite was obtained

with a varian Associates V 4502-EPR spectrometer equipped with an X-band microwave bridge and a V-4531 cavity. The sample was taken in a 3 mm. (O.D.) quartz tube sealed under nitrogen. The frequency was calibrated with a Hewlett-Packard frequency counter and the magnetic field was standardized with a proton probe. A field modulation of 100 KC/S was used.

The e.s.r. spectrum (the first derivative of the absorption curve) of the irradiated compound drawn at room temperature consisted of a single absorption line and was slightly asymmetric. The g value calculated for the cross-over point of the spectrum is 2·017. The line width ΔMs (width between points of maximum slope taken from the first derivative of the e.s.r. spectrum) is 11·4 gauss. No hyperfine splitting was obtained even under the maximum resolution.

From the e.s.r. spectral data obtained for gamma irradiated alkali thiosulphates[1,2] and sodium dithionite[3] it has been tentatively suggested that SO_2^- ion produced under irradiation is responsible for their e.s.r. spectra. This radical ion has a g factor of 2·005 and ΔMs around 11·0 gauss. The g value of 2·017 obtained in the present experiment has a considerable g shift from the free spin value of 2·0023 and it is unlikely that SO_2^- ion is present in gamma-irradiated rongalite. By their observations on liquid sulphur and other sulphur compounds, Gardner and Fraenkel[5] have made the tentative suggestion that polyatomic free radicals in which the odd electron is primarily associated with a sulphur atom would be expected to have a g value of about 2·02. The g factor of 2·017 obtained with gamma-irradiated rongalite could mean that its e.s.r. spectrum might be due to a free radical in which the odd electron is mainly localised on a sulphur atom. There is a large g shift from the free spin value and it is further suggested that the odd electron species in the irradiated rongalite are involved in considerable spin-orbit coupling.

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Dept. of Post-Graduate   D. S. MAHADEVAPPA.
Studies and Res. in Chem., A. S. ANANDA MURTHY.
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Mysore-6 (India),   D. DEVAPRABHAKARA.**
May 31, 1967.

   * Shri Ram Research Institute, New Delhi, India.
   ** Department of Chemistry, Indian Institute of Technology, Kanpur, India.

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CHEMICAL EXAMINATION OF *BAUHINIA PURPUREA* FLOWERS

ISOQUERCITRIN and astragalin (kæmpferol-3-glucoside) have been isolated from the fresh flowers of *Bauhinia purpurea* (Hindi—Khairwal, N.O. Leguminosæ), with a small amount of quercetin in the free state.

Isoquercitrin along with some quercetin from the fresh flowers of *Bauhinia tomentosa*,[2] kæmpferol-3-glucoside and kæmpferol-3-rhamno-glucoside from the white flowers of *Bauhinia variegata*[3] have been reported earlier. An anti-N reagent has been reported from the seeds of *Bauhinia purpurea*. Oil of the seeds has also been analysed.

Fresh flowers (1 kg.) were extracted in methanol by cold maceration twice and the combined extract was concentrated *in vacuo*. The aqueous methanolic extract after successive extractions with petroleum ether (40–60°) and ether responded to Mg and HCl test and greenish-brown ferric chloride reaction. The concentrated ethereal extract revealed the presence of quercetin (identified through its penta acetyl derivative), which was confirmed by comparing its m.p., Rf value UV and IR spectra with those of an authentic specimen. Two colouring matters have been separated by the lead salt technique from the aqueous methanolic extract, which were identified as isoquercitrin (m.p. 220–22°; yield, 1·5 g.) obtained from neutral lead acetate and astragalin (m.p. 176–78°; yield, 2·5g.) obtained from basic lead acetate.

Hydrolysis and quantitative estimation of sugars revealed the presence of glucose (identified as Osazone) as monoglucoside in both the colouring matters and the aglycones were identified as quercetin for isoquercetin and kæmpferol for astragalin. Isolation of 5, 7, 3′, 4′-tetra methyl quercetin and 5, 7, 4′-trimethyl kæmpferol on methylation followed by hydrolysis confirmed that both the colouring matters were 3-glucosides. The presence of these glucosides may account for the medicinal value of the flowers.

The authors wish to thank Dr. J. D. Tewari for his valuable suggestions during the course of this investigation. The authors are grateful

to Dr. T. R. Seshadri, University of Delhi, for providing authentic samples of quercetin and kæmpferol.

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SOME NEW 6-BROMO-S-SUBSTITUTED-2-THIO-3-ARYL (OR ALKYL)-4-QUINAZOLONES

SEVERAL 4-quinazolone derivatives and 2- or 4-sulphanilamido-quinazolines have been reported to be therapeutically active.[1,2] Several potential antimalarials belonging to substituted quinazolones and quinazolines have been screened against blood-induced *P. gallinaceum* infection in 7-day-old chicks. Also, febrifugine, an alkaloid having 3-substituted 4-quinazolone structure, has been reported to possess high antimalarial activity though a low therapeutic index.[2]

Gujral *et al.* observed the hypnotic activity of 2-alkyl-3-aryl-4-(3 H)-quinazolones in rats.[3] Further interest in the study of quinazolones was revised after they were reported as Central Nervous System depressants.[4] The anticonvulsant properties of QZ-2 (2-methyl-3-o-tolyl-quinazolone, available commercially as Melsedin) have been reported in mice, rats and dogs.[5-8] A potent anticonvulsant property of BDH 1880 (2-methyl-3-bromophenylquinazolone hydrochloride) has been reported against metrazole-induced convulsions in mice.[9]

The above findings have led the authors to prepare S-substituted-2-mercapto-3-aryl-4-quinazolones[10-11] as possible antimalarials and potential ataractic agents.[12] In the present communication, the synthesis of 6-bromo-S-substitued-2-thio-3-aryl (or alkyl)-4-quinazolones from 5-bromo-anthranilic acid,[13] aryl (or alkyl) isothiocyanates and alkyl halides has been studied.

EXPERIMENTAL

6-Bromo -2- thio -3- phenyl-4- quinazolone.—A mixture of 5-bromoanthranilic acid (11·9 g.), phenylisothiocyanate (6 ml.) and absolute ethanol (50 ml.) was refluxed on a water-bath for about 4 hours. The product was washed with ethanol, dissolved in 10% sodium hydroxide, precipitated with dilute hydrochloric acid, filtered, and after washing with water, dried.

Similarly, various 6-bromo-2-thio-3-aryl (or alkyl)-4-quinazolones were prepared from the corresponding isothiocyanates and 5-bromo-anthranilic acid. They were crystallized from glacial acetic acid. Their yields, melting points and analytical data are listed in Table I.

TABLE I
6-Bromo-2-thio-3-aryl (or alkyl)-4-quinazolones

S. No.	Aryl (or alkyl) group-R-	Yield %	M.P. °C.	Mol. formula	Nitrogen % Found	Nitrogen % Calcd.	Sulphur % Found	Sulphur % Calcd.
1	Phenyl-	75	325d	$C_{14}H_9N_2SOBr$	8·38	8·41	9·57	9·61
2	*o*-Tolyl-	80	313	$C_{15}H_{11}N_2SOBr$	8·13	8·07	9·32	9·21
3	*m*-Tolyl-	85	309	$C_{15}H_{11}N_2SOBr$	7·99	8·07	9·29	9·21
4	*p*-Tolyl-	80	320d	$C_{15}H_{11}N_2SOBr$	8·09	8·07	9·15	9·21
5	*m*-Chlorophenyl-	95	299	$C_{14}H_8N_2SOBrCl$	7·50	7·62	8·65	8·71
6	*p*-Chlorophenyl-	88	319	$C_{14}H_8N_2SOBrCl$	7·59	7·62	8·78	8·71
7	*o*-Methoxyphenyl-	80	279	$C_{15}H_{11}N_2SO_2Br$	7·70	7·71	8·80	8·81
8	*p*-Methoxyphenyl-	90	304	$C_{15}H_{11}N_2SO_2Br$	7·79	7·71	8·92	8·81
9	*p*-Ethoxyphenyl-	85	322d	$C_{16}H_{13}N_2SO_2Br$	7·49	7·43	8·62	8·49
10	Methyl-	80	273	$C_9H_7N_2SOBr$	10·29	10·33	11·70	11·80
11	Ethyl-	75	245	$C_{10}H_9N_2SOBr$	9·73	9·83	11·09	11·23
12	*n*-Butyl-	70	238	$C_{12}H_{13}N_2SOBr$	8·98	8·95	10·12	10·22
13	Benzyl-	70	233	$C_{15}H_{11}N_2SOBr$	8·01	8·07	9·35	9·21

Letters to the Editor

TABLE II

6-Bromo-2-methylthio-3-aryl (or alkyl)-4-quinazolones

S. No.	Aryl (or alkyl) group-R-	Yield %	M.P. °C	Mol. formula	Nitrogen % Found	Nitrogen % Calcd.	Sulphur % Found	Sulphur % Calcd.
1	Phenyl-	60	214	$C_{15}H_{11}N_2SOBr$	8.01	8.07	9.18	9.22
2	o-Tolyl-	67	156	$C_{16}H_{13}N_2SOBr$	7.72	7.76	8.86	8.86
3	m-Tolyl-	70	169	$C_{16}H_{13}N_2SOBr$	7.85	7.76	8.90	8.86
4	p-Tolyl-	59	238	$C_{16}H_{13}N_2SOBr$	7.86	7.76	8.78	8.86
5	m-Chlorophenyl-	62	171	$C_{15}H_{10}N_2SOBrCl$	7.35	7.34	8.40	8.39
6	p-Chlorophenyl-	45	236	$C_{15}H_{10}N_2SOBrCl$	7.42	7.34	8.31	8.39
7	o-Methoxyphenyl-	55	158	$C_{16}H_{13}N_2SO_2Br$	7.45	7.43	8.52	8.49
8	p-Methoxyphenyl-	90	207	$C_{16}H_{13}N_2SO_2Br$	7.51	7.43	8.50	8.49
9	p-Ethoxyphenyl-	53	234	$C_{17}H_{15}N_2SO_2Br$	7.09	7.16	8.00	8.18
10	Methyl-	75	168	$C_{10}H_9N_2SOBr$	9.75	9.83	11.10	11.23
11	Ethyl-	65	138	$C_{11}H_{11}N_2SOBr$	9.40	9.36	10.66	10.70
12	n-Butyl-	50	106	$C_{13}H_{15}N_2SOBr$	8.62	8.56	9.72	9.79
13	Benzyl-	68	126	$C_{16}H_{13}N_2SOBr$	7.70	7.76	8.81	8.86

TABLE III

6-Bromo-2-ethylthio-3-aryl (or alkyl)-4-quinazolones

S. No.	Aryl (or alkyl) group-R-	Yield %	M.P. °C.	Mol. formula	Nitrogen % Found	Nitrogen % Calcd.	Sulphur % Found	Sulphur % Calcd.
1	Phenyl-	50	152	$C_{16}H_{13}N_2SOBr$	7.79	7.76	8.77	8.86
2	o-Tolyl-	75	114	$C_{17}H_{15}N_2SOBr$	7.51	7.47	8.50	8.53
3	m-Tolyl-	70	135	$C_{17}H_{15}N_2SOBr$	7.59	7.47	8.60	8.53
4	p-Tolyl-	90	180	$C_{17}H_{15}N_2SOBr$	7.48	7.47	8.57	8.53
5	m-Chlorophenyl-	75	172	$C_{16}H_{12}N_2SOBr Cl$	7.00	7.08	8.18	8.09
6	p-Chlorophenyl-	60	185	$C_{16}H_{12}N_2SOBrCl$	6.95	7.08	8.07	8.09
7	o-Methoxyphenyl-	55	134	$C_{17}H_{15}N_2SO_2Br$	7.12	7.16	8.11	8.18
8	p-Methoxyphenyl-	80	154	$C_{17}H_{15}N_2SO_2Br$	7.23	7.16	8.22	8.18
9	p-Ethoxyphenyl-	65	153	$C_{18}H_{17}N_2SO_2Br$	6.85	6.91	7.86	7.90
10	Methyl-	85	108	$C_{11}H_{11}N_2SOBr$	9.23	9.36	10.61	10.70
11	Ethyl-	50	83	$C_{12}H_{13}N_2SOBr$	8.98	8.95	10.13	10.22
12	n-Butyl-	45	76	$C_{14}H_{17}N_2SOBr$	8.10	8.21	9.49	9.38
13	Benzyl-	95	98	$C_{17}H_{15}N_2SOBr$	7.37	7.47	8.50	8.53

TABLE IV

6-Bromo-2-n-propylthio-3-aryl (or alkyl)-4-quinazolones

S. No.	Aryl (or alkyl) group-R-	Yield %	M.P. °C.	Mol. formula	Nitrogen % Found	Nitrogen % Calcd.	Sulphur % Found	Sulphur % Calcd.
1	Phenyl-	60	175	$C_{17}H_{15}N_2SOBr$	7.41	7.47	8.49	8.53
2	o-Tolyl-	67	99	$C_{18}H_{17}N_2SOBr$	7.13	7.20	8.32	8.23
3	m-Tolyl-	85	148	$C_{18}H_{17}N_2SOBr$	7.21	7.20	8.29	8.23
4	p-Tolyl-	92	146	$C_{18}H_{17}N_2SOBr$	7.26	7.20	-8.30	8.23
5	m-Chlorophenyl-	64	172	$C_{17}H_{11}N_2SOBrCl$	6.84	6.84	7.75	7.81
6	p-Chlorophenyl-	69	185	$C_{17}H_{11}N_2SOBrCl$	6.93	6.84	7.89	7.81
7	o-Methoxyphenyl-	55	121	$C_{18}H_{17}N_2SO_2Br$	6.95	6.91	7.93	7.90
8	p-Methoxyphenyl-	75	165	$C_{18}H_{17}N_2SO_2Br$	6.99	6.91	7.81	7.90
9	p-Ethoxyphenyl-	61	134	$C_{19}H_{19}N_2SO_2Br$	6.60	6.68	7.53	7.64
10	Methyl-	65	84	$C_{13}H_{13}N_2SOBr$	8.90	8.95	10.10	10.22
11	Ethyl-	70	82	$C_{13}H_{15}N_2SOBr$	8.82	8.56	10.13	9.79
12	Benzyl-	64	81	$C_{18}H_{17}N_2SOBr$	7.12	7.20	8.11	8.23

6-Bromo-2-methylthio-3-phenyl-4-quinazolone.
—To a solution of sodium hydroxide (5 g.) in 85 ml. of 50% aqueous ethanol, 6-bromo-2-thio-3-phenyl-4-quinazolone (8·5 g.) was added. The solution was then stirred, filtered and treated with methyliodide (4 ml.); after being stirred again for an hour, the solution gave a crystalline product which was washed first with water and then with ethanol. Long needles were obtained on crystallization from ethanol.

Similarly, various 6-bromo-S-substituted-2-thio-3-aryl (or alkyl)-4-quinazolones have been prepared. Their yields, melting points, and analytical data are recorded in Tables II to IV.

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A DIFFERENTIATED DOLERITE DYKE FROM CHANDRAGIRI, CHITTOOR DT., ANDHRA PRADESH

THE differentiated dolerite dyke is noticed 1 km N.W. of Chandragiri. The dyke is 6 to 7 metres wide and can be traced along its strike for 1 km. It strikes E.W. and has intruded into coarse-grained granite. The chilled border is dark aphanitic enclosing microphenocrysts of zoned plagioclase and clino pyroxene. Within few centimeters from the border the rock rapidly grades into coarser type showing a typical basaltic texture. It is increasingly coarser towards the centre with subophitic to ophitic texture and acquires a little interstitial micropegmatite.

The three specimens collected, (1) a few centimeters away from the contact, (2) at the center, and (3) in between the two were chemically analysed. The chemical analyses together with calculated C.I.P.W. norm are given in Table I.

From Table I it is evident that there is a gradual increase in silica, alumina, titania and alkalies and decrease in magnesia and lime from

TABLE I

		KA1	KA2	KA3				KA1	KA2	KA3
							C.I.P.W. norms			
SiO_2	..	50·28	52·02	55·96	Q			1·56	7·26	10·32
TiO_2	..	0·96	1·08	1·13	Or			3·34	5·00	7·23
Al_2O_3	..	13·39	14·78	16·60	Ab			8·91	9·96	22·01
Fe_2O_3	..	1·16	1·96	1·75	An			30·02	32·53	30·02
FeO	..	8·67	9·67	7·66	Di	Wo		15·78	9·05	2·44
						En		9·20	4·50	1·20
MnO	..	0·24	0·24	0·24		Fs		5·81	4·36	1·19
MgO	..	8·76	6·18	4·34	Hy	En		12·70	11·00	9·70
						Fs		7·79	10·30	10·03
CaO	..	13·86	11·06	7·43	Mt			1·86	3·02	2·55
Na_2O	..	1·08	1·23	2·62	Il			1·82	2·13	2·13
K_2O	..	0·64	0·83	1·22	Ap			0·34	0·34	0·34
P_2O_5	..	0·15	0·13	0·15	H_2O			0·81	0·82	1·02
H_2O	..	0·81	0·82	1·02						
Total	..	99·98	100·00	100·12				99·94	100·27	100·18

KA1—Border part of the dyke,   KA2—In between KA1 and KA3,   KA3—Central part of the dyke.
Analyst : K. Anjanappa.

sample KA1 to KA3. Iron increases in the initial stage and decreases in the later stage.

The normative minerals, *viz.*, quartz, felspars and pyroxenes with iron ores, when plotted on Q.L.M. diagram, show that the magma composition steadily changes from basic to slightly acidic one (Fig. 1 Curve I) due to differentiation. The course of crystallization of dolerite is also evident in the alkali-total iron-magnesia diagram (Fig. 1 Curve II). The curve is concave downwards indicating iron enrichment with respect to magnesia in the initial stages and enrichment of alkalies in the later stages. The alkali enrichment during the course of crystalization is shown on lime-soda-potash diagram (Fig. 1. curve III).

FIG. 1. Variation in the composition of the dyke during the course of crystallization. The numbers 1, 2 and 3 in the curves correspond to the analyses in the Table KA1, KA2 and KA3 respectively.

It will be evident from the above that, within a single intrusive mass, which is here in the form of a dyke, evidences of differentiation are clearly discernible. These observations are similar to those made by other authors on the differentiation of the dolerites (Walker and Poldervaart, 1949,[1] Mc Dougall, 1962,[2] 1964[3])

The author thanks Prof. M. G. Chakrapani Naidu for his helpful suggestions, and Dr. K. V. Suryanarayana for his guidance.

Dept. of Civil Engineering,   K. ANJANAPPA.
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ALKALI-POOR BIOTITES FROM THE VELENCE MTN. GRANITES, HUNGARY

THE author while working on the geology of the Velence Mtn. region, Hungary, studied the minerals occurring in the granites of that area, in greater details. Thus the biotites occurring in these granites were separated and were got analysed in the Chemical Laboratories of the Geological Survey of Hungary, Budapest. The results of the chemical analysis are given below :

SiO_2	..	..	..	..	33·24
TiO_2	..	..	..	..	3·02
Al_2O_3	..	..	..	..	15·60
Fe_2O_3	..	..	..	..	3·54
FeO	..	..	..	..	25·61
MnO	..	..	..	..	0·71
MgO	..	..	..	..	5·79
CaO	..	..	..	..	1·63
Na_2O	..	..	..	..	0·28
K_2O	..	..	..	..	3·84
$- H_2O$	..	..	..	..	0·40
$+ H_2O$	..	..	..	..	5·86
P_2O_5	..	..	..	..	0·70
CO_2	..	..	..	..	0·00
					100·22

Analysts—Nemes Lajosné
       Soha Istvánné

On comparison with the chemical analyses of biotites from granites as quoted in the literature,[1,5,6] it is found that the biotite in question is poor in alkalis, being extremely so in potash. In order to visualise this feature, the contents of the three oxides, *viz.*, SiO_2, K_2O and Na_2O (as obtained from the chemical analyses) were recalculated to 100. Based on these values, a triangular variation diagram was drawn (Fig. 1). This diagram clearly shows that the

FIG. 1. SiO_2, K_2O & Na_2O variation diagram for the biotites from granites. (⊙ Biotite from granites of Velence mtn. region, Hungary).

alkali-content of the biotite in question is extremely low which in itself indicates that the biotite under study is unusual as the analysed biotite falls far away from the field of common

biotites. It is to be noted further that in the construction of this variation diagram, only granites were chosen, some of them being alkali-granites.

There is yet another feature which needs explanation. The granites of the Velence Mtn., Hungary, are richer in alkalis, especially so in potash as compared to the alkali-contents of the granites, the world over. For this purpose comparison was made with the alkali-contents of the following granites :

Average chemical composition of 474 analyses of granites from Japan,[3]

Average chemical composition of 131 analyses of granites from Finland,[3]

Average chemical composition of 45 analyses of granites from Great Britain[3] and

Average chemical composition of a granite from 546 analyses as given by Daly.[2]

Thus though the Velence Mtn. granites are rich in alkalis, the biotites from these rocks are abnormally poor in these oxides.

The author is grateful to the Director, Geological Survey of Hungary, Budapest, for getting the biotite sample analysed in his chemical laboratories.

Department of Geology,   N. W. Gokhale.
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A PRELIMINARY INVESTIGATION OF PALAEOCURRENTS IN CENTRAL AND SOUTH-WESTERN PARTS OF VINDHYAN BASIN

Systematic study of Vindhyan palæocurrents has been taken up for deciphering basin configuration and its probable extension under younger formations. The palæocurrent patterns in this investigation were reconstructed on the basis of primary sedimentary structures such as cross-bedding, ripple marks, tool marks and parting lineation in the Vindhyan sandstones.

From Rewa sandstones exposed around Sagar, the azimuths of 297 cross-beds were obtained

with a mean direction of sediment transport towards west. The standard deviation from the mean vector was insignificant.

At Bhopal within the Bhander sandstones measurements of 71 cross-beds were obtained giving the mean direction of transport towards N 30° E. (Raizada, 1967).

In the Dhar forest area 370 cross-bed data indicates a vector mean direction of sediment transport towards N 60° E. The average of 23 asymmetrical ripple marks in Dharikotla-Jamoti region gives palæocurrent direction towards N 45° E. The mean vector of 21 parting lineation measurements near Punnassa Dam site indicates the palæocurrent along N 50° E-S 50° W direction. Thus in the Dhar forest area, south of Narbada, the palæocurrent movement was towards NE.

Figure 1 indicates the distribution of palæocurrents observed in the three mentioned areas. Some data in the Son valley Vindhyans (Banerjee and Sen Gupta, 1963) and near the northern limit of Vindhyan exposures in Mirzapur and Agra Districts given by Jafar *et al.* (1966) are also incorporated in Fig. 1.

FIG. 1

The basic palæocurrent problem in the main Vindhyan basin can be solved only by systematic study of various litho. types and variations within the litho units and between the litho units. At present the data on Vindhyan palæoccrrents are rather scanty for obtaining a complete picture.

On the basis of the preliminary data presented in this note it is evident that three different palæostream current directions emerge. This would indicate that the grouping of the entire thickness of sandstones into Bhander series is questionable. If so, the heavy mineral studies in this key horizon under progress will throw new light on the Bhander Sandstone series in the Vindhyan basin.

I am indebted to Prof. W. D. West for help and encouragement in the present project.

Centre of Advanced Study   S. K. MISHRA.
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University of Saugar,
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A NEW OCCURRENCE OF *GINKGOITES FEISTMANTELII* BOSE AND SUKH DEV (1958)[2] FROM THE COASTAL GONDWANA OF SOUTH INDIA

THIS species of the genus *Ginkgoites* was established from the Jabalpur Series from the South Rewah Gondwana basin. All the specimens were collected from Machrar river section, near Marwar Ghat, about half a mile NNW of Bansa in Madhya Pradesh. To the best of the writer's knowledge, this is the singular occurrence of the species.

The same species has been found for the first time in the Raghavapuram Mudstone of the Coastal Gondwana formations of Andhra Pradesh. The specimen (Fig. 1) has been

FIG. 1

collected from the middle of the hill, locally called Bara Konda ($\triangle$ 437') near the village Raghavapuram (81° 19′ 42″ E : 17° 02′ N, G.T.S. 65 G/8).

Description.—Lamina reniform, about 1·5 cm. long × 1·2 cm. broad, border thick (? revolute), margin entire all throughout except a conspicuous apical notch in the upper margin, the lower margin continued as a narrow neck forming a short petiole of about 0·5 cm. length; veins few in number, about four, originating from the petiole diverge towards the lamina dichotomizing two to three times. *Specimen No.* SKB 19/11/1/62.

It compares very well with the paratype specimen No. 30632 (Text-Fig. D and Photograph No. 15 of Plate 3) of Bose and Sukh Dev (*op. cit.*).

In the context of the limited number of the reported occurrences of the fossil *Ginkgoales* in India, the present find would help this particular species attain importance in stratigraphic distribution. None of the other three Indian species of *Ginkgoites*, viz., *G. crassipes* Feistm., *G. lobata* Feistm. and *G. rajmahalensis* Sah and Jain[2] has yet been found over widely separated regions to be judged as having any significant, biostratigraphic correlative value. Keeping aside the complex problem of the precise biostratigraphic correlation of the Coastal Gondwana formations with the floristically delineated stratigraphic units such as Rajmahal Series, Jabalpur Series and Umia Series, it may be said here that the present find adds one more element to the existing twelve common species (Feistm.[3]) found both in the Jabalper Series and in the Raghavapuram Mudstone.

Geol. Studies Unit,   SUBHENDU KUMAR BAKSI.
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A NOTE ON THE ORBICULAR STRUCTURE IN THE QUARTZITES OF NARNAUL

DURING the course of recent geological investigations in the Narnaul area of Mahendergarh District, Haryana, the senior author came across a well-developed orbicular structure (Fig. 1) in the quartzites belonging to Delhi Series (Sikka *et al.*[1]).

These structures have been formed around the nuclei of para-amphibolites which have deve-

loped in the predominantly arenaceous rocks by the metamorphic differentiation of the original

FIG. 1. Showing orbicular structure in quartzites of Narnaul, × 1/5.

calco-pelitic impurities. The rims around the nuclei are essentially of quartz. The process involved appears to be similar to that described by the authors[2] in the case of secretion pegmatites from the same area. In this particular case the process operating during the course of the development of these structures was concretion principle of metamorphic differentiation.

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Centre of Advanced Study   S. B. BHATIA.
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PTILOPHYLLUM HORRIDUM SP. NOV. FROM TRAMBAU, KUTCH

A NEW species of *Ptilophyllum* (*P. horridum*) is described here from Trambau, Kutch. The species is based on a large number of carbonized leaves.

Description.—Fronds incomplete. Pinnæ closely set, attached at wide angle, with their entire base on the upper surface, concealing the rachis entirely. Upper cuticle devoid of stomata, hairs or papillæ. Cells mostly rectangular, lateral- and end-walls sinuous. Lower cuticle heavily papillate and divided into stomatal and non-stomatal bands. Marginal non-stomatal bands devoid of papillæ. Cells of

remaining non-stomatal bands having more than one papillæ per cell. Stomatal bands broader

FIGS. 1-2. *Ptilophyllum horridum* sp. nov. Fig. 1. A frond, × 1, No. 31889 of Birbal Sahni Institute of Palæobotany. Fig. 2. A stoma and a few papillæ (*p*, papillæ ; *st*, stoma), × 500, Slide No. 31889-2 of Birbal Sahni Institute of Palæobotany.

and more thickly papillate than non-stomatal bands. Papillæ variously shaped, semi-lunar or dome-shaped, adjacent papillæ often connected with each other. Cell walls obscure. Stomata irregularly scattered within the bands, mostly transversely orientated but a few slightly oblique. Stomata mostly concealed by the papillæ of the neighouring cells. Guard cells well cutinized, subsidiary cells without papillæ.

P. horridum is closely comparable with *P. indicum* Jacob and Jacob (1954),[1] *P. cutchense* (Morris) Jacob and Jacob (1954)[1] and

P. hirsutum Harris (1949)[2] in having stomatal and non-stomatal bands. *P. cutchense* differs from the present species in the nature and distribution of papillæ. The absence of papillæ over the subsidiary cells in *P. horridum* distinguishes it from *P. hirsutum* and *P. indicum*.

I am grateful to Dr. R. N. Lakhanpal for kindly going through the manuscript.

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PARASITIC COPEPODS, *CALIGUS POLYCANTHI* GNANAMUTHU INFESTING A BALISTID FISH, FROM SOUTH-EASTERN INDIAN OCEAN

DURING the 35th Cruise of the U.S.S.R. Research Vessal "Vityaz" in the South-Eastern sector of the Indian Ocean, a young form of a balistid fish was captured at station 5207 (Lat. 9° 57′ S., Long. 91° 32′ E.) on 29th August 1962, which was found to be infested profusely with adults and Chalimus stages of a Caligid Copepod. The balistid fish measuring 87·0 mm. in total length has been identified as *Canthidermis maculatus* (Bloch) which is widely distributed in all warm waters. The Copepods have been identified as adults and Chalimus stages of *Caligus polycanthi* Gnanamuthu. About 110 specimens of adult males and male and female Chalimus stages ranging from 0·5–2·0 mm. in size were found on the skin of the host. The adult females with egg sacs were present in the branchial chamber only, and 4 were recorded on the right side.

In this young balistid fish, the scales of the head have several small spinules, those on the sides of the body and caudal region bear large spines with ridges radiating from the base and these ridges also bear small spinules. The bases of these spines and spinules may probably afford easier holds for the attachment of the parasites to the host, resulting in heavy infestation.

The Chalimus stages were attached to the skin of the host by their frontal stalks while the adults were attached by the first antennæ. The second joints of the two-jointed second antennæ bear stout recurved, sharp pointed claws which also may be used for clinging.

Gnanamuthu[1] (1949) reported the infestation of 12 specimens of the same parasitic Copepod on the skin of *Canthidermis maculatus* (Bloch) from Madras. The present record is of interest in that (*i*) the distribution of the parasitic Copepod *Caligus polycanthi* Gnanamuthu is extended to the South-Eastern Indian Ocean and (*ii*) the host-parasite-species-relationship is confirmed. Moreover, such a heavy infestation of an external parasitic Caligid Copepod on a single fish host is uncommon. Therefore, it is considered worthwhile to photograph and record this infestation.

FIGS. 1–2. Fig. 1. *Caligus polycanthi* Gnanamuthu infesting on *Canthidermis maculatus* (Bloch). (Many parasites were detached due to feeble attachment). Fig. 2. Same as in Fig. 1 showing anterior region enlarged.

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HYPOTRICHOMONAS OSMANIAE N. SP., FROM A VARANID LIZARD

DURING the course of a survey of the intestinal flagellates of reptiles of Hyderabad, an interesting parasite belonging to the genus *Hypotricho-monas* Lee (1960)[1] (order Trichomonadida : family Monocercomonadidæ : subfamily Hypo-trichomonadinæ) was found in the rectal contents of *Varanus* sp. The infection was found in six out of the forty-two lizards examined and in all the cases, the parasites were associated with those of the genus *Mono-cercomonas.* The present species is the first of this genus to be recorded from Indian reptiles. The parasite is typically pear-shaped in the living condition, but tends to become spherical or fusiform on fixation (Figs. 1, 4, 6). The organelle of the body comprises of a blepharo-plast, three anterior flagella, a trailing flagellum with a poorly developed undulating membrane, an axostyle, a pelta and a nucleus.

The blepharoplast, situated at the anterior end, gives origin to the four flagella. The anterior flagella are unequal and measure $9 \cdot 25$-$16 \cdot 97 \mu$, $12 \cdot 85$-$22 \cdot 11 \mu$ and $14 \cdot 40$-$24 \cdot 16 \mu$ with averages of $13 \cdot 41 \mu$, $17 \cdot 76 \mu$ and $19 \cdot 95 \mu$ respectively. The posterior flagellum runs backwards along the body surface, attached to it for some distance (Figs. 1, 2, 6, 7). The attached portion is thrown into one or two undulatory folds and is supported by a thin membrane (Figs. 2, 7). The size of these folds seems to be variable in the different forms. The attachment of the flagellum to the body surface is about half or two-thirds the body length, being more in forms where the undulatory folds are shallow and less where the folds are more pronounced. Beyond the attached portion, the flagellum is free for a considerable length and trails behind the body. The free part is $12 \cdot 85$-$30 \cdot 85 \mu$, with an average of $20 \cdot 63 \mu$.

The axostyle is tubular and straight. It is almost of uniform thickness throughout its length, except the posterior part which is spine-like and protrudes outside the body (Figs. 4, 5, 7) for a distance of $1 \cdot 00$-$7 \cdot 20 \mu$. Endo-axostylar granules and peri-axostylar chromatic rings are absent.

The pelta is curved and shaped like an inverted 'comma'. It arises from the blepharo-plast and is directed sidewards (Fig. 3). The costa is absent.

FIGS. 1-7. *Hypotrichomonas osmaniæ* n. sp. Fig. 1. Showing general structure. Figs. 2, 7. Showing a short undulating membrane with deep fold. Fig. 3. Showing pelta. Figs. 4, 5. Showing origin of flagella. Fig. 6. Showing pelta and a long undulating membrane with shallow folds. (Figs. 1, 2, 4, 6, 7 from material fixed in methanol and stained with giemsa. Figs. 3, 5 from material fixed in Schaudinn's and stained with Heidenhain's hæmatioxylin). (All figs. × 1,000).

There is a large and ellipsoidal nucleus, situated just behind the blepharoplast. It measures about $2 \cdot 03 \times 1 \cdot 94 \mu$, on the average.

The cytoplasm contains many deeply staining granules and bacteria, showing the capacity of the organism to ingest foreign particles, even though a definite cytostome was not seen. The body of the parasite measures $7 \cdot 20$-$13 \cdot 88 \mu \times 4 \cdot 11$-$12 \cdot 85 \mu$ (Av. $9 \cdot 94 \times 6 \cdot 65 \mu$).

The only complete description available of a species of this genus is that of *H. acosta* described by Moskowitz (1951)[2] and later redescribed by Lee (1960).[1] *H. acosta* is ovoidal or spherical and measures $4 \cdot 00$-$17 \cdot 00 \mu \times 2 \cdot 50$-$15 \cdot 00 \mu$, while the present one is pear-shaped or fusiform and shows a much limited range in its size. The anterior flagella of the new form are relatively longer. The trailing flagellum of the old form is acronematic while it is not so in the new form. The axostyle of the parasite under discussion is slender and straight while that of *H. acosta* is more robust and is

distinguished into a spatulate capitulum and a twisted trunk.

Geiman and Wichterman (1937)[3] recorded an organism from land tortoises and this also probably belongs to this genus. However their description was too brief and inadequate to establish the proper identity. Nevertheless, that organism was reported by them to possess equal anterior flagella while the present one has clearly unequal ones.

In view of the differences, the parasite described from *Varanus* sp. is considered new to science and designated *Hypotrichomonas osmaniœ* n. sp.

I am extremely thankful to Dr. S. S. Qadri for his help and advice throughout the work. I am also thankful to Dr. S. N. Singh and Dr. S. M. Ali for providing me the facilities and for their constant encouragement.

Department of Zoology,   R. Krishnamurthy.
Marathwada University,
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STEPHANOFILARIAL DERMATITIS IN AN INDIAN ELEPHANT

Members of the genus *Stephanofilaria* Ihle and Ihle-Landenberg (1933) are causatively connected with a prominent and serious form of dermatitis in animals. The infection has been known to occur among cattle, buffaloes, goats and rhinoceros. The lesions are located at different places on the skin, including that of the ear in bovines. Leucoderma on the muzzle in cattle in the Amami and Ryukyeu Islands (Japan) has been attributed to a species of *Stephanofilaria* (Kono, 1964). The genus comprises eight species, viz., *S. dedoesi* Ihle and Ihle-Landenberg (1933), *S. stilesi* Chitwood (1934), *S. kœli* Buckley (1937), *S. assamensis* Pande (1936), *S. zaheeri* Singh (1958), *S. andamani* Sinha and Das (1958), *S. dinniki* Round (1964) and S. sp. Rono. Except *S. dinniki* which is found in the African black rhinoceros, all the other species infect ruminants. In this paper is recorded the first case of Stephanofilarial dermatitis in an elephant.

During the course of a parasitological survey of domestic animals in Assam, a domestic male elephant in Cacher was found in 1957 with a sore resembling Stephanofilarial lesion. The

sore was 1″ × ½″ in size and located on the left side on the back a little ahead of the shoulder blade, just in front of the site of the saddle. The lesion was covered with crust under which was found sticky pus. After the removal of the pus, the lesion was red in colour and rich in blood and lymph. From the deep scrapings of the sore, several female specimens of *Stephanofilaria* were recovered. Five specimens were measured and the average length was found to be 7·7 mm., with a width of 120–153 microns at the middle of the body length. The valva was situated at 89 to 94 microns from the anterior end of the body. The cuticle along the entire length of the body was transversely striated, the striations being quite prominent. The anterior end had the characteristic structures of the genus (Fig. 1). The posterior end of the female was straight (Fig. 2). A detailed

FIG 1

morphology of the parasite will be published separately after a recovery and study of male specimens.

The parasite from elephant, on account of its host, is tentatively assigned to a new species. *Stephanofilaria srivastavai*, n. sp., named in honour of the eminent Indian Helminthologist, Dr. H. D. Srivastava.

The author is grateful to Dr. H. D. Srivastava for confirming the generic identification of the

worm and for his help in the preparation of this paper. He is grateful to Dr. J. M. Bujarbarua,

FIG. 2

Director of Animal Husbandry and Veterinary Department, Assam, Gauhati, and Dr. R. N. Hazarika, Principal, Assam Veterinary College, Khanapara, Gauhati, for their encouragement.

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N.B.—The author has recently recovered many female and male specimens of the parasites collected from some of the elephants in the State.

ENZYME STUDIES IN NEMATODE INFECTED ROOT-KNOTS OF THE TOMATO PLANT

MYUGE[1] AND OTHERS[2] observed that the root-knots produced by *Meloidogyne* spp. showed decreased amounts of free sugars and increased enzyme activities. In a previous study[3] of the tomato root-knots, the dehydrogenase activities were found to be higher with respect to succinate, malate, glycerol, alcohol, and formic dehydrogenases, compared to the uninfected roots. The glucose dehydrogenase and the total endogenous reductase activities in root-knots of the tomato plant infected with the root-knot nematode *Meloidogyne incognita* var. *acrita,* were studied in continuation of the previous work.

Glucose dehydrogenase.—Two grams of the root-knots and a similar weight of the uninfected roots of the tomato plant were used for the assay. The method used for enzyme extraction was as described previously.[3] The incubation mixture consisted of 5 ml. of citrate-phosphate buffer (pH $5 \cdot 6$)[4] extract, 1 ml. of $0 \cdot 1\%$ glucose solution and 1 ml. of $0 \cdot 1\%$ freshly prepared triphenyl tetrazolium chloride (TTC) solution. The mixture was incubated at 45° C. for 30 min. after which the reduced red coloured formazon indicating the enzyme activity was estimated at 420μ in a Lumetron colorimeter, along with artificially reduced TTC standards as per the method of Kun and Abood.[5] In another series root-knots of different sizes were used for the study. Five replicates were conducted for the first set of experiments and triplicates were conducted for the second series. The results are tabulated (Table I).

Endogenous Reductase.—$1 \cdot 0$ gm. aliquots of the root-knots and a similar weight of the uninfected roots were used for this study. The materials were washed and cut to thin slices, and incubated at 37° C. for one hour in a buffered TTC mixture, which consisted of 5 ml. of phosphate buffer (pH $7 \cdot 2$) and $1 \cdot 0$ ml. of freshly prepared TTC solution. The red formazon in the tissues was extracted with $9 \cdot 0$ ml. of toluene, by grinding the slices in mortar. The intensity

TABLE I
Showing the amount of TTC reduced due to glucose dehydrogenase activity in healthy roots and root-knots of the tomato plant

Healthy root*	Root-knot*	Root-knot size	µg. of TTC reduced
$7 \cdot 2 \pm 0 \cdot 02$ µg.	$12 \cdot 7 \pm 0 \cdot 02$ µg.	2 mm. × 5 mm.	$2 \cdot 3 \pm 0 \cdot 01$
		5 mm. × 10 mm.	$3 \cdot 9 \pm 0 \cdot 01$
		10 mm. × 18 mm.	$6 \cdot 2 \pm 0 \cdot 02$
		20 mm. × 25 mm.	$7 \cdot 9 \pm 0 \cdot 02$

* 2 gm. weight

of the formazon was estimated at 420 μ. Formazon standards (1 μg. to 25 μg.) for matching with the unknowns, in colorimetric estimations were prepared as follows : 100 mg. TTC were reduced artificially by reacting with 10% NaOH. The formazon that was obtained was dried and known quantities taken in toluene to give varying dilutions.

In another series of experiments, root-knots of different sizes were cut to slices and used for the study. Triplicates were conducted for both the studies and the results are tabulated (Table II).

enzyme activities met with in the root-knots reflect the metabolic activities in the root-knots. The higher enzyme activities seen in the infected roots show the reactions of the host plant during infection. It is quite likely that the host plant is able to combat the infection by way of increased enzymic activities, which might be providing the necessary energy through the dehydrogenases and endogenous reductases, many of which are known to take part in energy providing mechanisms.[9]

TABLE II

Showing the amount in μg. of TTC reduced by endogenous reductase activity in the healthy roots and root-knots of the tomato plant

Healthy root*	Root-knot*	Root-knot size	μg. of TTC reduced
3·7±0·01	9·3±0·01	1 mm.× 2 mm.	0·12±0·01
		5 mm.×10 mm.	0·45±0·01
		15 mm.×20 mm.	0·84±0·01

* 1·0 gm. weight.

It was observed that the dye reduction was higher in the root-knots than in uninfected roots, and this was more so, as the size of the root-knot increased. Mattson et al.[6] have shown that the reduction of TTC in plant and animal tissues at pH neutral and below, is due to enzyme activity and that the nonenzymic reduction of TTC by reducing substances like ascorbic acid, sugars, cysteine and glutathione takes place only at very high alkaline pH. Fred and Knight[7] have also shown that TTC is reduced in *Penicillium chrysogenum* by endogenous reductases. Since the pH of reactions in the present studies was neutral and below, it is quite evident that glucose dehydrogenase reduced TTC in the first series, and endogenous reductases reduced TTC in the second series of experiments.

Observations have shown that there was heavy accumulation of the formazon in the region of the cortex in the root-knots, where usually giant cell formation occur during nematode infections. Many metabolic disturbances such as starch disappearance, accumulation of amino-acids, etc., are known to occur in the root-knots.[8]

In a previous study[3] it was shown that ascorbic acid and glutathione increased in quantity in the root-knots. Giant cell formation and tissue breakdown are the usual features associated with the nematode infections in the root-knots. The accumulation of formazon in the cortical regions and the increased

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UTILIZATION OF NITRITE NITROGEN BY *DRECHSLERA SOROKINIANA*

THERE are varying reports of the failure to utilize nitrite nitrogen by fungi.[1,2] An experiment was therefore conducted to test the ability of *Drechslera sorokiniana* (= conidial *Cochliobolus sativus*) to utilize nitrite nitrogen. The fungus was grown in Richard's medium but the source of nitrogen, *i.e.*, potassium nitrate was replaced with potassium nitrite. Nitrogen was supplied at four different levels, *viz.,*

2·5, 5·0, 10·0 and 20·0 mg. N. per 50 ml. of the culture medium, the appropriate amount of potassium nitrite being computed to supply these levels of nitrogen. The initial pH of the media was adjusted to 5·5 and 7·5. Observations regarding mat weight (Table I) and drift in pH (Table II) were made after 12 days incubation.

It is evident from the data (Table I, Fig. 1) that the fungus did not grow at any of the

TABLE I

Showing mat weight in mg. per flask containing 50 ml. of medium

Initial pH	Concentration of nitrogen			
	2·5 mg. N/ 50 ml.	5 mg. N/ 50 ml.	10 mg. N/ 50 ml.	20 mg. N/ 50 ml.
5·5	0·0	0·0	0·0	0·0
7·5	84	105	148	193

TABLE II

Showing drift in pH

Initial pH	Concentration of nitrogen			
	2·5 mg. N/ 50 ml.	5 mg. N/ 50 ml.	10 mg. N/ 50 ml.	20 mg. N/ 50 ml.
5·5	5·5	5·5	5·5	5·5
7·5	7·4	7·4	7·6	7·7

FIG. 1. Showing effect of pH and concentration of nitrite nitrogen on growth of *Drechslera sorokiniana*.

concentrations of nitrogen when the initial pH of the medium was 5·5. However, the fungus

grew well at all the levels of nitrogen when the initial pH was adjusted to 7·5. The mat weight increased with increasing concentration of nitrogen, being the lowest when the concentration of nitrogen was 2·5 mg. N/50 ml. and the highest when the concentration was 20 mg. N/50 ml. This shows that the concentration of nitrite nitrogen has no adverse effect on growth. On the other hand, the initial pH of the culture medium is a vital factor affecting growth. It may be mentioned here that Patel and Kulkarni[3] concluded that *D. sorokiniana* does not utilize nitrite nitrogen. Evidently, this was due to the fact that they adjusted the pH of the medium to approximately 7·0 and not in the alkaline range. In the acid range, where it is generally in the form of undissociated nitrous acid, nitrite is known to be toxic to fungi.[4-6] The undissociated form of an acid has the greatest biological activity.[7] Efficient utilization of nitrite nitrogen in the alkaline range appears to be due to the fact that the formation of nitrous acid, which has toxic effects, is probably prevented under such conditions. Similar beneficial effects on the utilization of nitrite nitrogen by shifting the pH to alkaline range have been reported for some other fungi.[8-10] In the light of the results reported here, it may be concluded that any report of failure to utilize nitrite nitrogen is suspect until the pH effect is excluded experimentally.

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STUDIES ON ENZYMES SECRETED BY *RHIZOPUS ARTOCARPI*

Rot of jack fruit (*Artocarpus heteropyllus* Lam. = *A. integrifolia* L.) caused by *Rhizopus artocarpi* Racib. is a very common and widely prevalent disease in Assam. As the organism belongs to a mould group causing rot it was felt that some enzymes might be associated with the decomposition as was observed by earlier workers.[1-4] The present experiment aims at elucidating the enzyme make-up of this fungus and the loss in weight caused due to disintegration of the tissues of the host thereby.

The fungus was isolated locally from young rotten fruits on P.D.A., purified by single spore isolation and maintained at room temperature (80-94° F.). For enzymic tests it was grown on sweet potato extract medium (Harter and Weimer[4]) using 50 ml. in 250 ml. Erlenmeyer flasks. After 13 days of growth the mycelial mat was strained, washed, dried, and kept inside a desiccator for 10 days. The dried mat was ground with sterile quartz sand in distilled water to facilitate extraction in the ratio of one part of mycelium in 20 parts of water and then filtered. A few drops of toluene were added to check contamination. The "crude enzyme extract" thus obtained was used to determine intra-cellular enzyme. The metabolic solution left as the filtrate was used for the determination of extra-cellular enzyme. Boiled distilled water was taken as control for comparison. The procedure adopted to detect the enzyme is referred under each test. Oxidase and reductase were determined on P.D.A. in petri dishes in which the required quantities of reagents were added. Control was kept without adding chemical.

It can be seen from Table I that the fungus secretes amylase, invertase, protease, protopectinase but not zymase, oxidase and reductase.

Amylase is secreted only extra-cellularly and protease gives a mixed reaction as extra-cellular enzyme. Strong pectolytic enzyme is secreted both intra and extra-cellularly and loss of coherence starts after two hours. After 3 hours translucent water-soaked areas develop on the potato discs and lemon rind discs change to ochraceous brown in patches. After 4 hours maceration of potato discs was started in extra-cellular extract and disintegrated after 18 hours with gas formation. Lemon discs also were macerated at this stage with slight gas formation in intra cellular extract which was profuse after 22 hours.

Water and acid-soluble fractions of the cell wall material were determined according to the method adopted by Baruah.[5] Peelings from the upper portion of the fruit were taken, dried and ground to a semi-powder mass. 500 mg. of it was added to 50 ml. of water, normal hydrochloric acid, 2% ammonium oxalate, respectively, in 250 ml. flasks and boiled for ½ hour. In case of water another set was kept without boiling. The result showed that water-soluble fraction varied from 12·1 to 38·1% (in unboiled and boiled, respectively) and the HCl fraction was 38·8%. Ammonium oxalate fraction was lesser, 23·0%.

Breakdown of the tissues was determined by placing 500 mg. of the powdered mass in 50 ml. of extra and intra-cellular enzyme extract and keeping for 24, 48 and 72 hours. These were then filtered, dried at 60° C. to constant weight. Table II shows that the extent of break-down of the tissues varied from 24·6% in case of intra-cellular enzyme to 25·1% in extra-cellular enzyme and the loss increased with the advance of time but the rate slowed down.

The test fungus shows secretion of strong pectolytic enzyme which may be a possible explanation for the quick decay of the young

TABLE I
Qualitative demonstration of enzymes

Enzyme	Substrate	Incubation period and temperature	Enzyme activity		Reaction
			Intra-cellular	Extra-cellular	
Amylase	Starch 5%	24 hr. at 37° C.	− − −	+ + +	Reduction of Fehling's soln.
Invertase	Sucrose 2%	do.	+ + +	+ + +	do.
Zymase	Glucose 1%	do.	− − −	− − −	do.
Protopectinase	(a) Potato discs	18 hr. at 37° C.	+ + +	+ + +	Maceration
	(b) Lemon rind discs	do.	+ + +	+ + +	do.
Protease	Gelatin 7%	24 hr. at 37° C.	+ + +	+ − −	Liquefaction
Oxidase	Pyrogallol 0·1%	6 days at 37° C.	− − −	− − −	Brown zonation around the colony
Reductase	Methylene blue 0·002%	do.	− − −	− − −	Formation of leuco compound around the colony

Each + or − sign stands for one tube or plate except in the case of protopectinase in which case each sign stands for one disc.

TABLE II
Decomposition of fruit tissues in enzyme extract

| Hours | Intra-cellular | | Extra cellular | |
	Loss in 500 mg.	p.c. of loss	Loss in 500 mg.	p.c. of loss
24	74·40	14·9	110·00	22·0
48	97·80	19·6	122·45	24·5
72	122·94	24·6	129·60	25·1

fruits. It also secretes some other carbohydrate splitting enzymes, as, amylase, invertase but not zymase. Therefore, it seems that *R. artocarpi* converts the complex carbohydrates of the cells into simpler sugars upto glucose level but not beyond that.

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Division of Mycology,   A. K. Roy.*
Department of Agriculture,
Assam, Jorhat, *March* 31, 1965.

* Present address : School of Agriculture, Edinburgh University, West Mains Road, Edinburgh-9, Scotland, U.K.

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CALCIUM ALUMINIUM PHOSPHATE— A PHOSPHATE REACTION PRODUCT IN INDIAN SOILS

FORMATION of the compound calcium aluminium phosphate [CaAlH $(PO_4)_2 \cdot 6 H_2O$] was observed by Taylor *et al.*[1] as a result of dissolution of gibbsite [Al $(OH)_3$] in concentrated acidic phosphate solution. Its probable formation in soils had been predicted by Lindsay *et al.*[2] but so far its actual formation in soils as reaction product from phosphate fertilizer has not been reported. Investigation carried out on the reaction of monocalcium phosphate, the main constituent of superphosphate and other phosphatic fertilizers with brown soil from Coimbatore and red soil from Bangalore revealed that this compound was one of the reaction products of phosphates in these soils.

The method utilized in the isolation of the reaction products has been reported.[3] X-ray diffraction analysis of the reaction products gave characteristic reflection at 6·52 Å together with other higher order reflections at 3·94, 3·78,

3·26 Å, etc. (Table I) which were the diagnostic criteria for the identification of this compound. The diffraction patterns were very well comparable with that of synthetic preparation of calcium aluminium phosphate by Lehr *et al.*[4]

TABLE I
X-ray diffraction patterns of calcium aluminium phosphate in reaction products isolated from 3 days' reaction of Coimbatore soil

Calcium aluminium phosphate [CaAlH $(PO_4)_2 \cdot 6H_2O$]

d (A)	I	d (A)	I
6·52	vs	2·68	w
4·08	vw	2·58	vw
3·94	s	2·39	vvw
3·78	w	2·16	vvw
3·36	vw	1·98	w
3·26	ms	1·87	w
3·15	vvw	1·81	mw

d—interplanner spacings in Angstrom unit; I—relative intensities; vs—very strong; ms—medium strong; s—strong; mw—medium weak; w—weak; vw—very weak; vvw—very very weak.

TABLE II
Chemical composition of reaction products isolated after 15 days

Soils	Reaction time with soils	CaO p.c.	Al_2O_3 p.c.	P_2O_5 p.c.
Coimbatore ..	5 hrs.	42·79	1·66	40·76
„ ..	3 days	27·86	4·34	37·10
Bangalore ..	½ hr.	35·40	1·70	42·14

Chemical analysis of the reaction products showed presence of Al in addition to Ca and P, thus confirming the formation of phosphate compound containing Al. The formation of this compound in these soils might be attributed to the dissolution of Al from soils and clays which were high in this constituent[5] under the influence of acidic monocalcium phosphate solution and subsequent precipitation of Ca, Al and P in the form of reaction product.

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REVIEWS AND NOTICES OF BOOKS

Raman Spectroscopy. Edited by H. A. Szymanski. (Plenum Publishing Corporation, 227 W, 17th St., New York, N.Y. 10011), 1967. Pp. ix — 255. Price $15.50.

Research in *Raman Spectroscopy* has received a powerful impulse by reason of the various recent developments, notably the discovery of *Resonance Raman Spectra* and the *Application of Laser Techniques*. The latter has opened up new possibilities which are being vigorously exploited in various laboratories. In consequence of these developments, the demand has arisen for a book in which the newer developments receive attention.

The volume under review includes specialized articles by eminent researchers in the field describing applications and techniques. It constitutes a co-ordinated, up-to-date study of one of the most rapidly developing branches of spectroscopy at a level suitable for both the beginner and the advanced researcher. It will enable the beginner to develop the technique and perspective necessary for effective use of the Raman spectroscopic method, and will suggest to the more advanced practitioner solutions to specific problems and ways to increase the range and precision of his investigations.

Chapter I, General Introduction by L. A. Woodward, contains the following articles : The Raman Effect; Quantum-Mechanical Theory of Light Scattering; Polarizability Theory of Rayleigh Scattering; General Polarizability Theory of Raman Scattering; Placzek's Simplified Polarizability Theory; Calculation of Force Fields from Frequencies; Raman Intensities on the Basis of Placzek's Theory; Experimental Measurement of Intensities; Bond-Polarizability Theory of Intensities; Relation of Bond Polarizability to Bond Character; Raman Spectra of Solids; Special Effects with Extremely High-Intensity Laser Excitation.

Chapter II, Advances in Raman Instrumentation and Sampling Techniques by John R. Ferraro, contains the following articles : Introduction; Raman Instrumentation; Sampling Techniques; Possible Future Developments.

Chapter III, Laser Raman Spectroscopy by J. A. Koningstein, contains the following articles : Introduction; General Experimental Techniques and Results; Specific Laser Raman Experiments and Results.

Chapter IV, Raman Intensities and the Nature of the Chemical Bond by Ronald E. Hester, contains the following articles : Theory of Raman Intensities; Bond Polarizability Derivatives; Bond Types from Raman Intensities— from Covalent Molecules to Ion Pairs; Bond Orders; Intermolecular Interactions in Liquids.

Chapter V, Ionic Melts by G. J. Janz and S. C. Wait, Jr., contains the following articles : Introduction; Techniques; Principles; Melt Spectra; Mixtures.

Chapter VI, Observed Resonance Raman Spectra by Josef Behringer, contains the following articles : Introduction; Special Features of Experimental Technique; Preresonance Raman Effect; Rigorous Resonance Raman Effect.

Chapter VII, Raman Spectroscopy of Complex Ions in Solution by D. E. Irish, contains the following articles : Introduction; Identity and Geometry; Equilibrium Constants; Thermodynamic Functions; Kinetics; Raman Spectra of Simple Complex Ions.

V. S. R.

The Chemistry of Lignin. By Irwin A. Pearl. (Marcel Dekker, Inc., 95 Madison Avenue, New York, 1967. Pp. xiii + 339. Price $15.75.

Botanists and plant physiologists have recognised for many years that a change occurs early in the development of the cell walls of the woody tissues of vascular plants whereby the cellulose is preserved to become hardened or lignified. The change comprises the addition to the cellulose of a substance or group of closely related substances which has been designated as lignin.

The chemistry of lignin has become a subject of wide interest to scientists of different disciplines ; organic chemists, botanists, microbiologists and soil chemists, not to speak of paper chemists. F. E. Brauns' book *Chemistry of Lignin* published in 1952 and its *supplement* published in 1960 are the well-known reference volumes on the subject. Work on lignin chemistry during the past ten years has provided new information which is found scattered in scores of published papers and review articles. There is a need for a concise publication as the present one to set forth the decade's progress in lignin chemistry since the publication of Brauns' volumes. The coverage in the book includes

the following : Lignin and its isolation, chemical structure, biosynthesis and formation, reactions in pupling and bleaching processes, chemical reactions, physical properties and preparation, biological and thermal decompositions, linkage in the plant, utilization.

A. S. G.

Basic Organic Chemistry. By R. J. Bessant. [McGraw-Hill Publishing Co., Ltd., London. Sole Distributors : The Book Centre (P) Ltd., Dadar, Bombay-28 DD], 1967. Pp. vii + 313. Price Rs. 31·50.

This is a thoroughly good book to understand the general principles of organic chemistry. It will be noticed that the usual division of organic chemistry into aliphatic and aromatic compounds has not been adopted. Instead, the treatment emphasises the reactions of the basic carbon skeletons and leads on to the reactions of the principal functional groups in all the usual structural situations. This will be evident from the following chapter headings : Valency of carbon, Alkanes, Alkines, Alkynes and Alkadienes, Aromatic Hydrocarbons, Petroleum and Coal, Halogen Compounds, Nitro Compounds, Amines, Hydroxy Compounds, Carbonyl Compounds, Carboxylic Acids and Carboxylic Acids and Derivatives, and Functional groups containing sulphur.

The book will provide a good introductory text-book to graduate students going in for an advanced course of organic chemistry.

A. S. G.

Experiments in Physical Chemistry. By D. Brennan and C. F. H. Tipper. [McGraw-Hill Publishing Co., Ltd., London. Sole Distributors in India : The Book Centre (P) Ltd., Dadar, Bombay-28], 1967. Pp. x + 254. Price Rs. 31·50.

This Laboratory manual provides a balanced course of essential experiments in physical chemistry to cover the practical syllabuses at the pre-University and graduate courses. The sixty experiments described in the manual have been selected to cover such a wide range of topics as physical molecular and surface properties ; phase equilibria and ionic equilibria, heats of reaction, chemical kinetics, cells and electrolysis ; analysis and radiochemistry.

Each experiment is systematically described under the heads Theory, Apparatus and material, Procedure, Treatment of results ; and Dis-

cussion. There are also an adequate number of illustrations. The loose leaf ring-bound volume will be convenient to handle.

A. S. G.

Lectures on Quantum Field Theory. By P. A. M. Dirac. (Academic Press, New York), 1967. Pp. viii + 151. Price $ 7.50.

This monograph published by the Belfer Graduate School of Science, Yeshiva University, New York, contains the lectures delivered by Professor Dirac at Yeshiva University during the academic year 1963–64. The text is from a transcribed version of the tape recording of the Lectures. Hence the style is extremely clear to be followed in all details.

Professor Dirac has developed in a logical manner the quantum field theory based on the Hamiltonian formalism in terms of equations of motion.

A. S. G.

Shift Register Sequences. By Solomon W. Golomb. Holden-Day Inc., 500, Sansome Street, San Francisco), 1967. Pp. xiv + 224. Price $ 8.75.

The author has brought together in one volume all relevant basic information about shift register sequences which have found a variety of technological applications in communications, digital ranging and tracking systems, computer sequencing and timing schemes. Earnest students interested in coding theory, switching theory or finite automata will appreciate the mathematical approach to the subject and the rigorous proofs presented in the treatment.

A. S. G.

Books on Polymers. Published by Marcel Dekker, Inc., 95, Madison Avenue, New York, N.Y. 10016.

1. **Organic Chemistry of Macromolecules.** By A. Ravve. 498 pages. Price $ 18.75 (1967).

This will serve as an introductory text-book for those students of organic chemistry who later take up an advanced course in polymer chemistry, or are employed in research activities in high polymers. The book covers the most important aspects of the chemistry of macromolecules under the following main heads : (1) Polymerization reaction mechanisms including free-radical polymerization, ionic

polymerization, complex catalysts polymerisation, stereo-specific polymerisation and emulsion polymerization ; (2)* Addition Polymers including macroalkanes, dienes and polyenes, styrenes, halogen-bearing polymers and Vinyl esters ; (3) Condensation Polymers including mechanism of reactions, polyesters, polyamides, polycarbamates, phenoplasts and aminoplasts ; (4) Naturally occurring polymers including polysaccharides, proteins and polynucleotides.

The treatment is throughout clear and systematic, and greater attention is given to synthetic macromolecules than to naturally occurring ones.

2. **Vinyl Polymerisation (Vol. I), Part I.** Edited by George E. Ham. 546 pages. Price $ 76.75 (1967).

This is the first issue in the projected series of three volumes to be devoted to a complete appraisal and present state of knowledge of the kinetics and mechanisms of polymerization. Contributors are authorities on the subject of their articles, belonging to industry or university or research establishment. The three volumes will respectively deal with I—Vinyl polymerization, II—Ring-opening polymerization and III—Condensation polymerization.

Volume I—Part I contains the following articles : General Aspects of Free-Radical Polymerization by George F. Ham ; The Mechanisms of Cyclopolymerization of Nonconjugated Diolefins by William E. Gibbs and John M. Barton ; Styrene by Maurice H. George ; Vinyl Acetate Polymerization by Martin K. Londemann ; Vinyl and Vinylidene chloride by Gianpietro Talamini and Evaristo Peggion ; Occlusion Phenomena in the Polymerization of Acrylonitrile and other Monomers by A. D. Jenkins ; Polymerization of Acrolein by Rolf C. Schulz ; and Heats of Polymerization and Their Structural and Mechanistic Implications by R. M. Joshi and B. J. Zwolinski.

3. **Polyaldehydes.** Edited by O. Vogl. 137 pages. Price $ 8.50.

This volume contains the papers presented at the symposium on "Polymerization of Aldehydes and Structure of Polyaldehydes" held at the Winter Meeting of the American Chemical Society in January, 1966. The symposium brings together the present status of our knowledge of aldehyde polymers. The papers are

of a review nature. Nine authors have contributed to the following papers : Polymerization of formaldehyde ; Polymerization and copolymerization of trioxene ; Polymerization of aliphatic aldehydes ; Polymers of haloaldehydes ; NMR studies of polyaldehydes ; Polymerization of fluorothiocarbonyl compounds ; Crystal structure of polyaldehydes ; Morphology of polyoxymethylene. An introductory chapter by the editor gives a brief history of polyaldehydes.

4. **High-Temperature Polymers.** Edited by Charles L. Segal. 197 pages. Price $ 8.75.

This volume contains the ten papers presented at the symposium on High-Temperature Polymers held at the Western Regional Meeting of the American Chemical Society, Los Angeles, in November, 1965. These papers grouped under organic polymers, inorganic polymers, and polymer degradation indicate the progress being made in this field of polymer research.

The Indian Ephemeris and Nautical Almanac for 1968. (Copies available from : The Managar of Publications, Civil Lines, Delhi-6 ; Outside India : The High Commission of India, India House, Aldwych, London W.C. 2), 1967. Pp. xxii + 468. Price : Inland Rs. 14·00 ; Foreign 32 *sh.* 8 *d.* or $ 5.04.

The present publication is the eleventh in the series on the Indian Ephemeris and Nautical Almanac and relates to the year 1968. Part V of this annual publication is specially intended to provide correct information on astronomical data to the large number of compilers in India of the annual *panchangas* in use in every household. The information covers an extended period up to March 23, 1969, *i.e.*, the end of the year 1890 Saka era of the Indian National Calendar.
A. S. G.

Books Received

Shift Register Sequences. By S. W. Golomb. (Holden Day, Inc., Amsterdam), 1967. Pp. xiv + 224. Price $ 8.75.

Problems and Solutions in Mathematical Physics. By Y. Choquet Bruhat. (Holden Day, Inc., Amsterdam), 1967. Pp. vii + 314. Price $ 10.00.

Mathematics for the Physical Sciences. By L. Schwartz. (Addison Wesley Publishing Co., Inc., London, W. 1), 1966. Pp. 357. Price $ 14.00.

ZONAL WINDS AND JET-STREAMS IN THE ATMOSPHERE

Sir C. V. RAMAN

THE atmosphere of the earth is a gaseous mantle which completely surrounds the globe and is held down to the surface by its own weight. Being a compressible gas, its density is determined by the pressure of its own weight and is accordingly a maximum at the surface of the earth and rapidly diminishes as we proceed upwards, becoming very low at great heights. The atmosphere is carried round by the earth in its annual motion around the sun, and it is therefore appropriate to regard it as an integral part of the earth in much the same way as the land masses or the oceanic waters. But a difficulty arises when we seek to extend the same idea to the behaviour of the atmosphere in relation to the rotation of the earth about its polar axis. The atmosphere enjoys a freedom of lateral movement in all directions transverse to the surface of the earth. It also possesses no fixed external boundary. It follows that the atmosphere is not rigidly coupled in its rotation about the polar axis. The question thus arises to what extent does the atmosphere actually follow the rotation of the earth about the polar axis, and what are the observable consequences of any differences between the atmosphere and the earth in regard to this rotatory movement.

The issues stated above are obviously of fundamental importance. Unless the questions which have been asked are squarely faced and satisfactorily answered, it seems scarcely possible to discuss the problems of atmospheric behaviour meaningfully and to reach a clear understanding of the same. Strangely enough, the meteorologists who are professionally interested in the dynamic behaviour of the atmosphere and are perfectly well aware of the basic role played by the rotation of the earth in their subject, have apparently been content to assume that the atmosphere goes round with the earth unless specially disturbed from that condition. Why it should so behave and whether it actually follows the earth in its rotation at all levels and in all latitudes is the problem which we shall proceed to discuss.

The surface of the globe presents a wide diversity in its appearance at various places. In particular, the areas of land and water are distributed in a very unequal manner in the northern and southern hemispheres. We shall, however, here ignore these differences and proceed to regard the surface of the earth as consisting of three distinct belts on each side of the equator, comprised respectively in the ranges of latitude from 0° to 30°, 30° to 60° and from 60° to 90°. The superficial areas of these three belts diminish quickly as we proceed from each to the next. Of particular importance also in relation to our present topic is the actual speed of motion at the surface of the rotating globe. This falls off as we proceed polewards from each belt to the next. It is 465 metres per second at the equator, 450 metres per second at 15° latitude and 403 metres per second at 30° latitude. In the second belt, the diminution of speed is much more rapid, being 329 metres per second at 45° and 232 metres per second at 60°. In the third belt it is still smaller, being 110 metres per second at 75° and zero at 90°. A further and highly noteworthy difference between the three belts is in respect of the heating of the surface of the earth by solar radiation and the turbulent movements in the atmosphere which arise by reason of its contact with the heated earth. These effects are highly pronounced in the first belt, moderate by comparison in the second belt, and relatively small in the third belt.

The coupling of the atmosphere to the earth in its rotation about the poles is attributable entirely to the forces acting at the surface of the globe when there is any

movement of the air relative to the solid or liquid material with which it is in contact. We shall here ignore the part played by molecular viscosity. The interactions with which we are concerned express themselves by producing eddies or turbulence in the vicinity of the interface. The question arises, how far would the effect of such eddies or turbulence extend and what would be their ultimate effect on the movement of the air at considerable heights above the surface or in regions remote from the areas where there is relative movement.

Considerations of a very general nature suggest that the further away we move from the actual surface of the earth, the less and less would be the controlling influence of any particular area of the surface on the movement of the parcel of air immediately above it. *Per contra*, we are justified in assuming that the air at any given height would be influenced in its movements by the movement of areas on the surface of larger and larger extent as we proceed upwards. At sufficiently high levels, the effective areas on the surface may be expected to be of very considerable dimensions.

The approach indicated above leads us to certain inferences. As has been remarked above, the three parts of the surface of the globe between 0° and 30°, between 30° and 60° and between 60° and 90°, differ widely in those characteristics which may be expected to determine or influence the rotation of the atmosphere above the surface in those belts. We may therefore feel justified in drawing the inference that the atmosphere of the earth would exhibit these differences very noticeably in its rotational behaviour. In other words, we may expect to find three distinct belts of atmospheric rotation in each hemisphere, a broad belt extending on either side of the equator from 30° north to 30° south, a belt in the middle latitudes between 30° and 60° and the third belt between 60° and 90°. In the equatorial belt, the speed of atmospheric rotation would be a maximum, being everywhere nearly the same as the speed

of movement of the surface at the equator itself. When we pass to the adjoining belt in the latitudes between 30° and 60°, the speed of rotation may be expected to exhibit a large and sudden drop to a smaller value, since the speed of atmospheric rotation would be determined by the much lower speeds of the surface of the earth in these latitudes. Finally, when we pass to the third belt in the latitudes between 60° and 90°, we may expect a further and fairly sudden slowing down of the rotational movement, by reason of the large fall in the speed of movement of the surface as we move to the highest latitudes.

The existence of these belts in which the movement of the atmosphere parallel to the circles of latitude differs in speed from the surface of the earth below would reveal itself to an observer located in those areas as a zonal wind, blowing from the east or the west as the case may be, the speed of the zonal wind being the difference between the speeds of the atmosphere and of the earth. In the broad belt which extends from 30° north to 30° south of the equator where the surface speed is a maximum, we may expect the atmospheric speed to be also a maximum at the equator and to differ but little from the speed of the surface below. Accordingly, at the equator itself, there would be no zonal wind. But, as we move north or south of the equator, the atmospheric speed would be greater than the speed of the surface. Accordingly, we would have in these regions an easterly wind which gains strength as we proceed north or south and which may be expected to reach its maximum speed at or about a latitude of 15° north or south. Beyond this, the easterly wind would diminish in strength and vanish when we reach the limit of the equatorial belt of easterly zonal winds at 30° latitude.

In the latitude belts between 30° and 60°, north or south of the equator, considerations of the same nature as those stated above for the equatorial belt indicate that an observer would find them to be regions in which there are zonal winds which appear to blow

from the west. These winds would naturally be weak at the surface and might be expected to be absent at the boundary between the zones of easterly and westerly winds. The westerlies would become stronger as we proceed polewards from this boundary. The considerations already set out indicate that the westerlies would gain notably in strength as we proceed to higher levels above the surface. For, the influence of the slowly-moving surface areas on the air-speeds aloft would then progressively become greater.

We may also expect to meet with zonal winds in the latitude range between 60° and 90°. The speed of movement of the surface goes down to zero at the poles, but elsewhere would be finite. Hence, if we assume the atmospheric speed to be determined by some sort of averaging over the surface speed, the air-speed everywhere in this belt would be greater than the surface-speed. Accordingly, in this region we would meet with easterly zonal winds.

We now proceed to consider the question of the elevation up to which the atmospheric layers which rotate faster or slower than the surface of the earth below may be expected to extend. The transference of momentum from the surface upwards into the atmosphere is made possible by the process of eddy diffusion. Where this process comes to a stop, the transference of momentum will also cease.

As is well known, the atmosphere of the earth falls roughly into two divisions referred to respectively as the lower and the upper atmospheres. The dividing surface between them is called the tropopause; the region below is the troposphere and the region above is the stratosphere. The troposphere is characterised by its exhibition of a steady fall of the atmospheric temperature as we proceed upwards, while in the stratosphere the temperature does not exhibit this feature, but remains approximately constant. The most recent studies indicate that the tropopause has a multiple structure, there being three distinct parts of it, one at low latitudes, one in the middle latitudes, and the third in high latitudes. The first is at the highest level, 16 kilometres or more. The second is between 10 and 12 kilometres above the surface and the third between 6 and 8 kilometres.

The tropopause is usually identified as the boundary between the regions in which heat transfer is principally by convection and turbulence, and those in which heat transfer is predominantly by radiation. On this basis, we can also identify the tropopause as the upper limit of the belts of air of which the speed of rotational movement differs from that of the surface below. It is readily understood on this basis why the tropopause exhibits a multiple structure as remarked above.

The recognition that there exist three wind-belts in the atmosphere with the characteristics already stated above enables a simple explanation to be given of the origin of the jet-streams which manifest themselves at fairly high levels in the atmosphere. There are two of these, *viz.*, one known as the polar-front jet and the other as the sub-tropical jet. The locations where these appear are the regions in the atmosphere where there is a steep fall in the atmospheric speed as we pass from one wind belt to the next. This steep fall manifests itself as a large increase in the zonal wind-speed.

CHEMICAL COMPONENTS OF *SALACIA CHINENSIS* LINN.:
STEMS AND LEAVES

V. KRISHNAN AND S. RANGASWAMI
Department of Chemistry, University of Delhi, Delhi-7

IN the course of studies on the Ayurvedic drug "Saptarangi", the chemistry of the stem and leaves of *Salacia chinensis* Linn. (Fam. Celastraceæ) was investigated. The powdered stem was extracted with warm petroleum ether, ether, warm acetone, cold alcohol and warm alcohol in succession and the respective solvent-free residues examined for their constituents. The petroleum ether extract yielded 0·2% of gutta (a linear isomer of natural rubber) whose identity was inferred from the following properties. The substance was a colourless crystalline powder when freshly crystallised from alcohol but acquired slight stickiness on long exposure to air and light. It melted at 57–65°; the cooled melt retained a glassy consistency for a long time. The substance analysed for $(C_5H_8)_n$. It rapidly decolourised a solution of bromine in chloroform to form a bromo compound which analysed for $(C_5H_8Br_2)$. Quantitative bromine titration and perbenzoic acid titration indicated the presence of one double bond per C_5H_8 unit. The proton signals in the NMR spectrum of the parent substance (using carbon tetrachloride as solvent and TMS as internal standard) agreed with the structure

$$(H_2C - \overset{\overset{\text{CH}_3}{|}}{C} = CH - CH_2)_n$$

qualitatively and quantitatively and the spectrum compared very well with that of the isoprenoid part in ubiquinone and Kofler's quinone.[1] Molecular weight (Rast method) was *ca* 1500. Gutta has been shown to occur in several species of the family Celastraceæ.

The ether and acetone extracts of the stem did not yield any definite substance. During the concentration of the cold as well as the subsequent warm alcohol extracts, a colourless crystalline solid separated from each; they were filtered separately and crystallised from hot water. They proved to be identical (m.p. and TLC). The substance, stout colourless prisms m.p. 187–88°, formula $C_6H_{14}O_6$, formed a hexaacetate m.p. 169°, $C_{18}H_{26}O_{12}$, and a hexabenzoate m.p. 188–89°, $C_{48}H_{38}O_{12}$, all optically inactive. These properties identified the substance as dulcitol (total yield 0·06%).

After removal of dulcitol the mother liquors from the cold and warm alcohol extracts were separately cncentrated under reduced pressure and the residues were macerated with cold ethyl acetate which extracted most of the material and then with cold methanol. The latter extract yielded no definite substance. The cold ethyl acetate extract in either case was concentrated to a low volume and diluted with dry petroleum ether. The solid obtained was repeatedly purified by taking in ethyl acetate and precipitating with petroleum ether. In either case the same proanthocyanidin was precipitated whose properties are described below :

The proanthocyanidin on boiling with ethanolic hydrochloric acid gave a deep red coloured flavylium salt which was obtained pure by preparative paper chromatography and identified as pelargonidin chloride by qualitative colour tests and by its absorption spectrum in 0·01% ethanolic hydrochloric acid solution (λ_{max} 535 mμ not affected by addition of aluminium chloride). No other anthocyanidin or catechin type of compound was present in the acid hydrolysate. This showed that the proanthocyanidin was made up of leucopelargo-

(1)

nidin units only. The proanthocyanidin m.p. 180–95° (d) (yield, 0·03%) formed a methyl ether (dimethyl sulphate and potassium carbonate in acetone medium). m.p. 130–35°(d), $[a]_D-39·3°$ (C, 0·29 in chloroform), $C_{36}H_{38}O_{11}$, H_2O. The methyl ether did not consume any periodate (vicinal glycol grouping absent). Its molecular weight (Rast method) was 630. Hence the proanthocyanidin should be a dimer

of leucopelargonidin having the probable structure (I) in which the linkage between the two C_{15} units is shown as C_4-O-C_4. Alternative linkages C_4-O-C_3 or C_3-O-C_3 are also conceivable.[2] The parent proanthocyanidin formed an acetate with acetic anhydride and pyridine at room temperature, m.p. $120-25°$ (d), $[\alpha]_D - 27 \cdot 7°$ (C, $0 \cdot 18$ in chloroform), $C_{46}H_{42}O_{19}$.

The leaves of *Salacia chinensis* were also similarly extracted with warm petroleum ether, ether, warm acetone and warm alcohol. The petroleum ether extract yielded gutta which was identified as described under the stem. The ether extract did not yield any definite substance. The solvent-free acetone extract was macerated with petroleum ether, ether and chloroform in the cold to remove waxes and colouring matter. An almost colourless solid remained. After repeated purification by taking up in methanol and precipitating with ether the m.p. was $218-30°$ (d) (yield $0 \cdot 1\%$). On boiling with ethanolic hydrochloric acid it gave rise to three flavylium salts (paper chromatography); the nature of the parent proanthocyanidin(s) is being investigated.

The warm alcoholic extract of the leaves after removal of solvents was treated in exactly the same manner as described under the acetone extract. The product, an almost colourless powder, m.p. $210-25°$ (d) (yield $0 \cdot 5\%$), also gave rise to three flavylium salts. The nature of this (these) proanthocyanidin(s) is also under investigation.

1. Isler, O., Ruegg, R. and Langemann, A., *Chemisch Weekblad*, 1960, **56**, 613.
2. Lewak, S., *Roczniki Chemii*, *Ann. Soc. Chim. Polonorum*, 1964, **38**, 1773; *C.A.*, 1965, **62**, 14615 c.

NMR STUDY OF MERCURIC SULFATE MONOHYDRATE

G. RANGARAJAN AND R. SRINIVASAN

Department of Physics, Indian Institute of Science, Bangalore-12

THE X-ray structural analysis of $HgSO_4.H_2O$ was first carried out by Bonefacic.[1] In their refinement of the structure, Templeton *et al.*[2] have commented on the hydrogen bonding in the structure. In view of these comments, it was thought interesting to undertake a PMR study of the single crystal.

$HgSO_4.H_2O$ belongs to the orthorhombic space group Pmcn $-D_{2h}{}^{16}$ with four molecules in the unit cell. The general positions are given by:

$$\pm [(x, y, z);\ (\tfrac{1}{2} - x,\ \tfrac{1}{2} - y,\ \tfrac{1}{2} + z);\ (\tfrac{1}{2} + x,\ \bar{y},\ \bar{z});\ (\bar{x};\ \tfrac{1}{2} + y,\ \tfrac{1}{2} - z)]$$

Crystallographically, there are two non-equivalent p-p vectors in any of the three crystal planes.

Large single crystals were grown in the manner described by Templeton *et al.* They were examined using a modified PKW-type of wide line NMR spectrometer constructed in our laboratory. The signals were recorded for 18 orientations of the magnetic field in the ab- and the bc-planes, at intervals of $10°$ each.

The Pake splitting of the signals due to dipolar interaction, $\triangle H$ (in gauss) is given by[3]:

$$\triangle H = 2a\ (3 \cos^2 \delta \cos^2 \overline{\phi - \phi_0} - 1).$$

The experimental derivative curves for the rotations in the ab- and the bc-planes looked similar to the curves usually obtained for a single p-p vector case. From each of these curves, a small central peak had to be subtracted before further analysis. This peak is presumably due to some free water in the crystal. The curves were resolved into Pake doublet derivatives, with a proper choice of a standard derivative curve from a well-resolved spectrum. The measured $\triangle H$-values were then fitted into the Pake equation by the method of least squares. The parameters r, ϕ_0 and δ thus obtained, specify the length and the orientation of the interproton vector with respect to the crystallographic axes.

The interproton distance, r, was found to be $1 \cdot 61 \pm 0 \cdot 03$ Å

TABLE I

Bond system	Distances in Å	Orientation of $O_A - O_B$ line				Orientation of P-P line				$O_A - O(\hat{H}_2O) - O_B$
		ab-plane		bc-plane		ab-plane		bc-plane		
		ϕ_0	δ	ϕ_0	δ	ϕ_0	δ	ϕ_0	δ	
$O(3) - O(H_2O) - O'(3)$	2·970, 3·136	172° 30′	57° 51′	4° 36′	31° 50′	175°	63°	5°	33°	117° 50′

FIG. 1. (100) Projection of Hg SO₄.H₂O.

For rotation in the ab-plane, with the a-axis as the reference axis,

$$\phi_0 = 175°, \quad \delta = 63°$$

and for rotation in the bc-plane with the c-axis as the reference axis,

$$\phi_0 = 5°, \quad \delta = 33°.$$

Hence, the projections of the *p-p* vector in the two planes are very nearly parallel to the *a*- and the *c*-axes respectively. It is due to this, that we have failed to observe sufficient resolution between the Pake curves corresponding to the two vectors, which are non-equivalent only in respect of their ϕ_0-values. In the ac-plane, however, the spectra observed were typical of two non-equivalent *p-p* vectors. The parameters are also consistent with the results obtained in the other two planes.

Hydrogen bonding : Each Hg atom in the unit cell has two close neighbours : O(3) at 2·17 Å, and O(H$_2$O) at 2·24 Å which are approximately collinear with Hg. The other four neighbours, O(2), are at the corners of a rectangle whose shorter sides are perpendicular to the mirror plane containing Hg, O(3) and O(H$_2$O). This mirror is a symmetry requirement of this space group.

Our NMR results are consistent with two possible sets of hydrogen bonds, as follows :

(*i*) One involving the O(2) atoms not related by the mirror symmetry, and (*ii*) another involving the O(3) atoms from adjacent unit cells. The scheme (*i*) however leads to the protons being located along the edges of the

co-ordination polyhedron and this is extremely unlikely.

The distances and angles calculated on the basis of the X-ray data are furnished along with the PMR results, for scheme (*ii*) in Table I.

The long bond distances involved suggest rather weak bonding ; this allows us to assume an O-H distance corresponding to the vapour value, *viz.*, 0·96 Å. This, together with the observed H-H distances of 1·61 Å, gives H-O($\hat{H}_2$O)-H as 113° 58′, which is near the O(3)-O(H$_2$O)-O'(3). Hence, we are led to suggest that the bonding to the O(3) atoms of adjacent unit cells is the probable one. The proposed hydrogen bonding is illustrated in Fig. 1.

Such a bonding appears to violate the mirror symmetry of the space group, and a neutron diffraction study of the crystal may be of interest.

We wish to thank Prof. R. S. Krishnan for his kind interest and encouragement.

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2. Templeton, L. K., Templeton, D. H. and Allen Zalkin, *Ibid.*, 1964, **17**, 933.
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UNIT-HAIR RECEPTOR ACTIVITY FROM THE TELSON OF THE SCORPION, *HETEROMETRUS FULVIPES*

K. SASIRA BABU AND P. SANJEEVA REDDY

Department of Zoology, Sri Venkateswara University, Tirupati, India

LITTLE is known of the functional properties of hair receptors in scorpions. The mechanoreceptive function of hairs of scorpion was mentioned by Rao (1964) and Laverack (1966). According to Rao (1963) the 'B' type of hairs are principally mechanoreceptive and are distributed on the appendages, opistosoma and metasoma. Behavioral responses such as escape, attack, withdrawal and alert, etc., can be readily evoked either by delivering puffs of air onto the animal or by mechanically manipulating the hairs, thereby signifying the importance of these hairs in mediating behavioral responses of the animal. In spite of this fact, no one has reported an electrophysiological analysis of the properties of these hair receptors. One of the 'B' type of hairs on the enigmatic telson is chosen because of its easy accessibility for manipulation and also due to availability of long nerve for recording purposes.

The scorpion, *Heterometrus fulvipes* was used. The animal was fixed on to a dissection board with ventral side up and the telsonic nerve was exposed by carefully excising the exoskeleton. After severing the central connections the nerve was placed on a pair of silver-silver chlorided electrodes and the impulses were simultaneously led to a loud-speaker and Philips GM 5666 oscilloscope, after duly amplifying them with Type 122 Tektronix preamplifier. Recordings were made in air at room temperature (27° C.) and scorpion ringer (Padmanabhanaidu, 1967) was used to moisten the nerve. Two methods were employed to impart mechanical stimuli to the hairs. In one method, a needle mounted on a micromanipulator was used for brief and sustained displacement of the hair. The stimulus signal was monitored through a liquid potentiometer. The second device, employed mostly for high frequency stimulation, consists

of a probe fixed on to the diaphragm of a loud-speaker. The loud-speaker connected to a driver circuit was driven by a Tektronix pulse generator. Air puffs of varying intensity were manually blown on to the hair through a fine capillary tube.

The response to air puffs (Fig. 1) is a brief burst of activity, consisting of one or two spike components, depending upon the rate of air puffs delivered. For slow blowing only small spikes of 50μ V are obtained (Fig. 1 a). For rapid blowing the discharge consists of a burst of spikes of two amplitudes (Fig. 1 b); the small spikes of 50μ V and big spikes of 100 to 150μ V.

The hair should be moved at a critical rate to obtain the single spike response (Fig. 2 b). Movements below this critical rate were found to be ineffective in eliciting the response (Fig. 2 a). Beyond the critical rate of stimulus a stepwise increase in response frequency was obtained for increasing rates of stimulus (Fig. 2 c and d).

Sustained stimuli were applied by moving the hair far above the critical rate, left in the displaced state for some time and then

spikes. Beyond the critical rate of movement, the response frequency is merely a function of rate of hair displacement. The response during the first 0·1 sec. corresponds to the high frequency zone when the instantaneous frequency is of the order of 200/sec.

The loud-speaker device was employed to cause small-scale vibrations of the hair at known frequencies. When the hair was subjected to stimulation at low frequences (10 to 40/s) the response was found to be in the form of bursts. For high frequency stimulation (100/sec.) the response was found to be in the from of solitary spikes. Beyond 100/sec. stimulus frequency the sense organ fails to respond in a one to one manner. In all these cases the magnitude $(2 v)$ as well as duration of stimulus (0·1 ms.) was kept constant; hence the above effects should be traced to repetitive frequency which is the only variable. From this observation it may be inferred that stimulus frequencies up to 100/sec. fall within the normal functional range of the sense organ.

FIGS. 1-3. Fig. 1. Air puff response to (a) slow and (b) fast blowing. Calibration: 200 ms. Fig. 2. Response to mechanical stimulation. In (a) no response can be seen because of subthreshold stimulation. In (b) at threshold stimulation a solitary spike and at increased rates (c and d) more number of spikes are elicited. Calibration: 200 ms. Fig. 3. Response to sustained mechanical stimulation. Note the initial high frequency response, followed by a gradual rate of adaptation and an off response. Calibration: 20 ms.

brought back to its normal position. The typical sensory response (Fig. 3) thus obtained can be dissociated into three phases: the initial and final high frequency zones; the maintained steady response zone and the low frequency adapting zone. The duration of the off dis-charge was very brief involving only a few

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LETTERS TO THE EDITOR

ON THE DETERMINATION OF K-CONVERSION COEFFICIENTS

ONE of the known methods[1] of determining K-conversion coefficients consists of measuring the number of K X-rays, N_κ, which accompany internal conversion in the K-shell relative to the number, N_γ, of unconverted γ-rays. If the measurement is made with a NaI(Tl) scintillation spectrometer the K-conversion coefficient α_κ is given by the relation

$$\alpha_\kappa = \frac{N_\kappa \epsilon_\gamma A_\gamma}{N_\gamma \epsilon_\kappa \omega_\kappa A_\kappa I_\kappa} \qquad (1)$$

where N_κ and N_γ represent the counts under the photo-peaks in the spectrum of the source for K X-rays and γ-rays, ϵ_κ and ϵ_γ denote the photo-peak efficiencies and correspond to the fraction of X-rays and γ-rays that lose full energy in the NaI(Tl) crystal of the detector, A_κ and A_γ account for the absorption of the X-rays and γ-rays in the air and the crystal package before reaching it. ω_κ is the K-shell fluorescence yield and accounts for those de-excitations of the excited daughter atoms which result in the ejection of Auger electrons and I_κ corrects for the escape of iodine X-rays from the crystal which are subtracted from the K X-rays photo-peak and reappear in the so-called 'escape peak'. The errors in the determination of α_κ arise mainly because of the uncertainties in the value of the factor

$$\frac{\epsilon_\gamma A_\gamma}{\epsilon_\kappa \omega_\kappa A_\kappa I_\kappa}.$$

We have measured the value of this factor experimentally. The principle of the method and the results are briefly described in this letter. The experimental details are omitted and will be reported elsewhere.

662 keV gamma-rays from Cs-137 source of strength about 200 mc. were scattered from a thin lead target through an angle of 90°. The X-rays of weighted mean energy (76·7 keV) emerging from the target as a result of photo-electric interaction and the Compton scattered gamma-rays of energy 280 keV from the target were recorded with the (1" × 1") NaI(Tl) detector which was later used to determine α_κ in Tl²⁰³. The ratio of the K X-rays and the Compton scattered γ-rays as measured under the photo-peaks of the spectrum of the radia-tion emerging from the target is given by the relation

$$\frac{N_\kappa}{N_c} = \frac{\sigma_\kappa}{\sigma_c} \frac{t_{\text{eff}.\kappa}}{t_{\text{eff}.c}} \frac{\epsilon_\kappa A_\kappa \omega_\kappa I_\kappa}{\epsilon_c A_c}$$

where σ_κ and σ_c are the photoelectric and Compton scattering cross-section for 662 keV gamma rays in lead. t_{eff} is the effective thickness of the target which takes into account the absorption of the incident and the emerging radiation in the target. The ratio of effective thicknesses was determined experimentally by using targets of thicknesses t, $2t$, $4t$......etc., as described earlier.[2] The other terms have been defined earlier. Twelve independent runs were made and the value of the factor

$$\frac{\epsilon_c A_c}{\epsilon_\kappa \omega_\kappa A_\kappa I_\kappa}$$

was found to be $0\cdot483 \pm \cdot017$. The target was then replaced by a weak Hg-203 source which emits K X-rays due to internal conversion in Tl-203 and the 280 keV unconverted gamma-rays and the spectrum was taken with the same geometry. The values of N_γ and N_κ were determined from the analysis of the spectrum. Since the energies of the Compton scattered γ-rays and K X-rays emitted from the lead target are almost the same as those of the Tl-203 γ-rays and K converted X-rays, the value of the factor

$$\frac{\epsilon_\gamma A_\gamma}{\epsilon_\kappa \omega_\kappa A_\kappa I_\kappa}$$

is the same as that of

$$\frac{\epsilon_c A_c}{\epsilon_\kappa \omega_\kappa A_\kappa I_\kappa}.$$

The value of α_κ was calculated from equation (1) to be $0\cdot159 \pm \cdot006$ which is compared with the previously determined values by this method in Table I.

TABLE I

Comparison of internal conversion coefficients determined by various authors by X/γ method

S. No.	Measured value	Reference No.
1	0·23 ±0·01	3
2	0·21 ±0·01	4
3	0·160±0·01	5
4	0·195±0·014	6
5	0·153± ·006	7
6	0·175±0·004	8
7	0·159± ·006	Authors

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ULTRASONIC STUDIES OF BINARY LIQUID MIXTURES: ANILINE-BENZENE AND ANILINE-CARBON DISULPHIDE

SETTE[1] studied the ultrasonic absorption of binary liquid mixtures of aniline with nitrobenzene and ethyl alcohol and reported a minimum in absorption at about 0.3 mole fraction, for both the binary mixtures and attributed this to molecular association, in the case of these polar liquids. Balachandran[2] reported a linear variation of velocity and compressibility of aniline-cyclohexane liquid mixture. From a study of the temperature dependence of absorption coefficient of pure aniline, Nomoto *et al.*[3] concluded that there is a contribution from bulk viscosity to ultrasonic absorption in this liquid.

With a view to study the behaviour of aniline with some other solvents, the authors have taken up the binary liquid mixtures, aniline-benzene and aniline-carbon disulphide. The absorption measurements are made with an error of $\mp 3\%$ employing pulse technique as developed by Pellam and Galt[4] and Pinkerton.[5] The velocity measurements are made to an accuracy of ± 1 m/sec., using an acoustic interferometer. The liquids benzene and carbon disulphide supplied by E. Merck and aniline by B.D.H. are used after distillation. Aniline is added to the solvents with a pipette of one ml. capacity and the mole fractions are estimated. The densities of pure liquids and mixtures are obtained using sensitive hydrometers, correct to third decimal place. For the binary mixture of aniline-benzene, the velocity and absorption measurements are made at a frequency of 8.9 mc/s and at a temperature of 26.5° C. In view of the large absorption coefficient for carbon disulphide, the measurements

are made at 2.86 mc/s for aniline-carbon disulphide mixture at a temperature of 22° C.

Figures 1 and 2 give, for the two binary mixtures aniline-benzene and aniline-carbon di-

FIG. 1

FIG. 2

sulphide respectively, the variation of absorption (a/f^2), the velocity and adiabatic compressibility with increasing concentration of aniline. It is found that in both the liquid mixtures, the velocity goes through a minimum at about 0.05 mole fraction of aniline and the adiabatic compressibility shows a maximum at the same concentration. This is similar to the occurrence of a velocity minimum at a low concentration, when a polar liquid is dissolved in a non-polar solvent as, for example, in the case of ethyl and methyl alcohols dissolved in carbon tetrachloride,[6] which may be ascribed to the presence of maximum number of polar molecules for this particular concentration.

The absorption values for both the liquid mixtures show the usual rapid monotonic

decrease with increasing concentration of aniline. This is similar to the phenomenon observed in the case of other benzene mixtures by Wada and Shimbo.[7] However, in the case of aniline-carbon disulphide mixture, there is a small maximum in the absorption curve (shown by dotted line), occurring at about 0·3 mole fraction. This result is significant in that the absorption exhibits this maximum in a non-polar solvent and that this maximum occurs at about the same concentration, as the minima reported by Sette (*loc. cit.*) for aniline-nitrobenzene and aniline-ethyl alcohol mixtures, where both the components of the mixtures are polar molecules. For a better understanding of the mechanism for the absorption maximum, it is necessary to obtain data at different temperatures and frequencies.

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Department of Physics,   M. VENKATESHWARLU.
Osmania University,   G. SIVARAMA SASTRY.
Hyderabad-7 (A.P.)
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$n-\pi^*$ ABSORPTION SPECTRA OF *o*-, *m*- AND *p*-TOLUALDEHYDE IN VAPOUR PHASE

SPECTRA due to the $n-\pi^*$ electronic transitions in carbonyl compounds have drawn the attention of several workers. Benzaldehyde is the simplest molecule among substituted benzenes which contain C=O group and its $n-\pi^*$ system has been studied extensively in absorption as well as in emission. Subsequently, the corresponding band systems for isomeric fluoro-, chloro- and bromobenzaldehydes[1-3] have been studied in absorption. A study of the electronic spectra of isomeric tolualdehydes has, therefore, been considered interesting. Raman spectra of these isomers have been studied by several workers.[4-5] The infared spectra of these isomers have been recorded by Singh and Singh.[6]

Since the absorption corresponding to $n-\pi^*$ transition is essentially very weak in all the three tolualdehydes ($f \cong 10^{-4}$ to 10^{-2}), it is not possible to record any absorption in this region at room temperature using absorption paths of less than a metre. Though a few bands could be recorded, they become too broad at higher temperatures.

The absorption spectra were photographed on a Zeiss Q-24 Medium Quartz Spectrograph with a slit-width of 15μ. Exposure time ranged from 10 minutes to $1\frac{1}{2}$ hours on Ilford N-40 plates. The atomic lines of copper were superposed to serve as standard. The bands were measured on a Hilger L 76 comparator.

Assuming the CHO and CH_3 groups to behave as single particles and a two-fold axis passing through them, the *p*-tolualdehyde molecule may be taken to belong to C_2, point group and the molecules *o*- and *m*-tolualdehydes would belong to C_s point group. In analogy with the spectrum of benzaldehyde the probable electronic transition responsible for the longest wavelength absorption spectrum of *p*-tolualdehyde is $^1B_1 \leftarrow {}^1A_1$ and that of *o*- and *m*-tolualdehydes will be $^1A' \leftarrow {}^1A'$.

The longest wavelength absorption bands of *o*-tolualdehyde are properly developed in a cell of 100 cm. length at 145° C. The spectrum consists of 14 bands lying in the region 3413-3834 A. The bands are degraded towards red and are broad and diffuse. The strong band at 26853 cm.$^{-1}$ has been taken as the (0, 0) band. The spectrum has been analysed in terms of three ground state frequencies (255, 630 and 780 cm.$^{-1}$) and eight excited state frequencies (506, 617, 700, 825, 990, 1090, 1187 and 1346 cm.$^{-1}$).

The longest wavelength absorption bands of *m*-tolualdehyde are properly developed in a cell of 120 cm. length at 80° C. The spectrum lies in the region 3257-3741 Å and consists of 35 red degraded bands. The band at 26943 cm.$^{-1}$, which appears quite intense even at very low vapour pressures, has been taken as the (0, 0) band. The spectrum has been analysed in terms of three ground state frequencies (130, 195 and 220 cm.$^{-1}$) and thirteen excited state frequencies (105, 135, 175, 195, 370, 405, 715, 805, 950, 1045, 1160, 1345 and 1465 cm.$^{-1}$).

The longest wavelength absorption bands of *p*-tolualdehyde are best developed in a 120 cm. cell at 90° C. The spectrum consists of 48 red degraded bands in the region 3044-3697 Å. The band at 27090 cm.$^{-1}$ is taken as the (0, 0) band of the system, which is found to be more intense

compared to any other band even at very low vapour pressures. The spectrum has been analysed in terms of eleven excited state frequencies (180, 195, 360, 590, 712, 805, 930, 1075, 1185, 1345 and 1525 cm.$^{-1}$).

The most prominent vibrational frequencies in the excited electronic state are 1346, 1345 and 1345 cm.$^{-1}$ in *o-*, *m-* and *p-*compounds respectively and these have been assigned to the C=O stretching mode.

The order of shift for the (0, 0) bands in A units is *o- > m- > p-*, which is the same as given by Morton and Stubbs[7] in the case of *o-*, *m-* and *p-*hydroxybenzaldehydes.

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VIBRATIONAL SPECTRUM OF 1-METHYL 9, 10-ANTHRAQUINONE

The visible emission spectra of anthraquinone and some of its monosubstituted derivatives studied during the course of the present investigations[1,2] have necessitated a knowledge of their vibrational frequencies in greater detail than obtained from their electronic spectra. These informations can be obtained from the Raman and infrared spectra of the compounds. Attempts made in this direction for substituted anthraquinones are meagre being confined to some selective regions of spectra. The infrared spectra of the compound in the C–H stretching and C–H out-of-plane bending regions have been recorded[3] with a view to study the shift in these frequencies by ring-additions. The C–O stretching vibrations have been studied by Josien and Deschamps.[4] However, no vibrational assignments of the observed frequencies have been made so far. Therefore, it was thought worthwhile to suggest the assignments of various frequencies observed in the present

infrared spectrum along with the Raman frequencies, the laser trace of which has been made available to us through the courtesy of Dr. Haber of Cary Instruments Lab., California, U.S.A.

The Eastman grade sample of 1-methyl 9, 10 anthraquinone was sublimed before use. The infrared spectrum was recorded with a Perkin-Elmer Spectrophotometer equipped with NaCl optics employing KBr technique. The concentration of the compound was varied between 1% and 2·5%.

TABLE I
Fundamental vibrational frequencies of 1-methyl 9, 10-anthraquinone

Raman cm.$^{-1}$	(Solid) Int.	Infrared cm.$^{-1}$	(Solid) Int.		Assignments
273	(1)			a^o	C=O bending o.p.
290	(1½)			a''	skeletal deformation o.p.
335	(2)			a'	C—CH$_3$ bending i.p.
372	(½)			a''	skeletal deformation o.p.
440	(1)			a'	C=O bending i.p
445	(8)			a'	skeletal deformation i.p.
652	(½)	653	(3)	a''	skeletal deformation o.p.
		655	(1)		C—H$_3$ wagging
		691	(1)	a'	skeletal deformation i.p.
696	(7)	702	(10)	a'	ring breathing
716	(1)	716	(2½)	a'	C—CH$_3$ stretching
750	(½)	743	(1)	a''	skeletal deformation o.p.
		806	(½)	a''	C—H bending o.p.
		810	(2½)		,,
850	(1)	849	(½)		,,
		890	(3½)	a'	C—H bending i.p.
		925	(1½)	a''	C—H bending o.p.
941	(½)	942	(6)	a'	skeletal deformation i.p.
963	(3½)	970	(5)	a''	C—H bending o.p.
		982	(1½)		,,
1012	(1)	1009	(1)		C—CH$_3$ rocking
1043	(2½)	1041	(2)	a'	C—H bending i.p.
1142	(2)	1142	(2½)		,,
1180	(4½)	1178	(2)		,,
1222	(3)	1222	(1)		,,
		1260	(4½)		,,
1281	(1)	1282	(9)		,,
1325	(1)	1326	(9)	a'	C—C stretching
1380	(1)	1352	(2½)		C—CH$_3$ bending (symmetric)
		1412	(2)	a'	C—C stretching
1430	(½)	1436	(1)		,,
1450	(½)	1452	(1)		C—CH$_3$ bending (asymmetric)
		1473	(1)	a'	C—C stretching
1595	(6)	1597	(8)		,,
1667	(10)	1671	(10)	a'	C=O stretching
		2864	(½)		C—H stretching in CH$_3$ group (symmetric)
		2950	(½)		C—H stretching in CH$_3$ group (asymmetric)
3032	(1½)	3026	(1)	a'	C—H stretching
3070	(2)	3062	(1)		,,
3096	(½)	3104	(½)		,,

i.p. = in-plane;   o.p. = out-of-plane.

The molecular symmetry D_{2h} of 9, 10-anthraquinone reduces to C_s when a CH_3 group replaces a hydrogen atom in 1-position. In addition, CH_3 group is assumed to lie in the plane of the molecule. Of the seventy-five normal modes of vibrations, 51 are symmetrical with respect to the plane of the molecule (a' type vibrations) while 24 are antisymmetrical (a'' type vibrations). In assigning the various frequencies to different modes of vibrations, assistance has been taken from the parent molecule[5] and some related compounds.[6-8] The assignments of the fundamental frequencies observed both in Raman and infrared spectra are shown in Table I.

The authors are thankful to Prof. N. L. Singh for the encouragement. They are also grateful to Dr. H. S. Haber of Cary Instruments Lab., California, U.S.A., for kindly supplying them the laser trace of Raman spectrum of the compound. One of them (S. N. S.) is thankful to U.G.C. for financial assistance.

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MOLECULAR CONSTANTS OF *CIS* AND *TRANS* N_2F_2

The *cis* and *trans* structure of N_2F_2 has been very well established recently.[1,2] The infrared spectrum of the compound was first taken by Sanborn[3] who also reported the valence force constants of the *trans* and 1, 1-difluorodiazine conformations. But in the light of the latest assignment by King and Overend[4] and structural information a reinvestigation of the force field has become necessary. In the present note, along with the force field (GVF and UBF), the generalised mean square amplitudes of vibration and coriolis coupling coefficients, which are important in electron diffraction and vibration-rotation interaction investigations respectively, are reported. The conventional Urey-Bradley force field has been modified by incorporating a *trans*-interaction term as described by Scherer and Overend.[5] The force constants, generalised mean-square amplitudes and coriolis coupling coefficients are given in Tables I, II and III respectively.

TABLE I

Force constants of cis and trans N_2F_2
(md/Å)

Force constants	General valence		Urey-Bradley	
	cis	*trans*	*cis*	*trans*
f_R	11·0000	11·0000	9·9190	10·4000
f_r	4·4695	4·5270	4·1100	4·3610
f_α	0·9875	0·9595	0·6256	0·9120
f_τ	0·6808	0·2973	0·6808	0·2973
f_{rr}	0·1915	−0·1500	..	..
f_{rR}	0·6902	0·2000	..	..
$f_{\alpha\alpha}$	0·1805	0·0205	..	..
$f_{r\alpha}$	0·1180	0·2506	..	..
$f_{r\alpha'}$	0·0000	0·0989	..	..
$f_{R\alpha}$	0·9605	0·4354	..	..
k_{12}	..	..	0·0000	0·1019
$F_{\varnothing\gamma}$	..	..	0·4321	0·0132
$F_{\gamma\gamma}$	..	..	−0·6506	−0·3427

TABLE II

Generalised mean-square amplitudes ($Å^2$) of cis and trans N_2F_2 at 300° K.

Atom pair	*cis*				*trans*			
	$\langle \Delta z^2 \rangle$	$\langle \Delta x^2 \rangle$	$\langle \Delta y^2 \rangle$	$\langle \Delta z \Delta x \rangle$	$\langle \Delta z^2 \rangle$	$\langle \Delta x^2 \rangle$	$\langle \Delta y^2 \rangle$	$\langle \Delta z \Delta x \rangle$
N = N	0·001606	0·002279	0·002904	0·000000	0·001582	0·003568	0·000000	0·000012
N − F	0·002383	0·003697	0·001769	−0·000501	0·002268	0·004257	0·005413	0·000315
N ... F	0·003492	0·002455	0·001000	0·000416	0·004112	0·003098	0·005413	0·000192
F ... F	0·097248	0·001178	0·001296	0·000000	0·007288	0·000073	0·000000	0·00 974

TABLE III
Coriolis coupling coefficients of cis and trans N_2F_2

Coupling	cis							trans			
	$a_2 \times a_1$			$a_1 \times b_1$		$b_1 \times a_2$		$a_u \times b_u$			
	ζ^z			ζ^y		ζ^x		ζ^x		ζ^y	
	S_1	S_2	S_3	S_5	S_6	S_5	S_6	S_5	S_6	S_5	S_6
S_4	-0.7188	0.3077	0.6240	S_1 -0.3564	0.8295	S_4 0.6181	-0.7498	S_4 0.9201	0.3867	-0.9223	-0.3914
..	..	..	..	S_2 -0.4721	-0.3958	..	..	..	..	..	..
..	..	..	..	S_3 0.7833	-0.0106	..	..	..	..	..	..

The parameters were taken from reference[1] and frequencies from[2]. There is good agreement between the results of the two force fields except in the value of the N=F stretching constant, f_R. The angle interaction amplitude σ_{aa} has been found to be equal to -0.001869 Å² (cis) and 0.003460 Å² (trans) and therefore the FNN angle interaction must be important. This may partly justify the introduction of the trans-interaction term k_{12} in the UBF of trans N_2F_2. The torsional mean-square amplitudes in trans must be more than that in cis because of the reciprocal trend of the frequencies. This may be responsible for the large values of the perpendicular mean square amplitudes of N=N and N–F bonds in trans N_2F_2.

One of the authors (K. B. J.) is thankful to the Ministry of Education, Government of India, for the award of a Research Fellowship.

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DUAL ACTIVITY OF CHROMIA-ALUMINA IN THE DECOMPOSITION OF ISOPROPANOL

THE dehydration and dehydrogenation activities of chromia-alumina catalysts have been investigated by many workers.[1,2] The present study is an attempt to understand the mechanism of the decomposition of isopropanol on chromia-alumina. The effect of contact time and partial pressures was studied using a flow type reactor described by Pandao.[3]

The dehydration increased with temperature while the dehydrogenation showed a decrease above 400° C. The catalyst is considered to change from p-type to n-type above 400° C.[4] The decrease in dehydrogenation may be due to this change. This implies that the rate-determining step involves the p-character of the catalyst and according to Wolkenstein's model,[5] it must be the desorption of acetone.

Increase in contact time caused the dehydrogenation to pass through a maximum. To explain a similar observation, Upreti[6] suggested that the attainment of equilibrium for the surface reaction is facilitated when acetone is relatively strongly adsorbed. Increase in contact time increases the partial pressure of acetone and the high temperature makes the catalyst more n-type; both favourable for acetone adsorption.

At lower temperatures, with increase in contact time no maximum was observed for the dehydrogenation because the conditions are not favourable for equilibrium of the surface reaction to be established. The dehydration increased with increase in temperature and contact time. This would mean that chromia is responsible for dehydrogenation and alumina for dehydration.

The presence of hydrogen with the alcohol increased the dehydrogenation. Acetone and cyclohexane were found to suppress the dehydrogenation, suggesting that the alcohol adsorption is inhibited. The dehydration activity remained unaffected. Water also suppresses dehydrogenation considerably. In low concentrations, water increases the dehydration, probably by increasing the surface hydroxyl groups. Pyridine suppresses the dehydration activity showing that the surface acidity is important for dehydration. The dehydration was not completely suppressed suggesting that even weakly acidic areas are enough for the dehydration. Unlike sodium[7] pyridine does not affect the

electronic nature of the catalyst and so does not increase the dehydrogenation.

When an equimolar mixture of acetone and hydrogen is sent over the catalyst at 412° C., the gaseous products contained isobutylene, propylene and hydrogen showing that acetone and hydrogen react to form isopropanol. Below 400° C. there was negligible reaction suggesting that an *n*-type surface favours the reaction. This confirms the conclusions drawn earlier that on a *p*-type catalyst, the desorption of acetone which is the rate-determining step is facilitated and the equilibrium for the surface reaction is not established. It is concluded that acetone during its adsorption retards dehydrogenation by reducing the donor nature of the catalyst thus preventing the alcohol from getting adsorbed, while hydrogen favours dehydrogenation by increasing the donor nature.

It may be considered that dehydrogenation is greatly affected by the chemisorption of substrates that affect the electronic character of the catalyst, while the dehydration depends only on the surface acidity and is affected only by bases neutralising the acidity. The rate-determining step for the dehydrogenation changes as the electronic nature of the catalyst changes, either due to the temperature or chemisorption of other substrates.

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AMPEROMETRIC ESTIMATION OF URANIUM WITH 2′ 3′ 4′-TRIHYDROXY CHALCONE

THE author reported that 2′, 3′, 4′-trihydroxy chalcone yielded an orange-red precipitate with UO_2^{++} ions at pH 5·9 to 8·4.[1] Since the reagent gave a well-defined polarographic wave at pH 6·1 in an acetate buffer with $E_{\frac{1}{2}}$ at $-1·155$ v (*Vs.* SCE), the reaction was investigated for the amperometric estimation of uranium.

Reagents and Apparatus.—An alcoholic solution (0·05 M; containing 12·8 mg. of reagent per ml.) of the reagent was used. Uranyl nitrate solution (0·01 M) was prepared from uranyl nitrate hexahydrate and its uranium content checked up by estimation by the oxine method. Acetate buffer of pH 6·5 was prepared from 1·0 M acetic acid and 1·0 M sodium acetate. 3·0 M KCl solution and 0·01% aqueous solution of thymol were employed as supporting electrolyte and maximum suppressor respectively.

Dr. Lange's polarometer, Model-3, a direct reading instrument coupled with a multiflex galvanometer (Type MGF 2) and Elico (L 1-10) pH meter were used for current voltage and pH measurements respectively. An H-cell of the type designed by Lingane and Laitinen[2] was used both for polarographic and amperometric studies.

Uranyl ions yielded a well-defined polarogram in acetate buffer with $E_{\frac{1}{2}}$ at $-0·33$ v (*vs.* SCE) with a diffusion plateau ranging from $-0·5$ v to $-0·8$ v (*vs.* SCE). The titrations were performed at an applied potential of $-0·5$ v, at which potential only uranyl ions yielded diffusion current whereas the reagent requires higher potential for the reduction. The concentration of acetate ion was maintained at 0·05 M in all the experiments to minimise the complexing effect on uranyl ions.

Estimation of uranium.—Known volumes of uranyl nitrate solution (containing *ca.* 2·0 to 14·0 mg. of uranium) were pipetted out into a 50 ml. volumetric flask. 2·5 ml. of acetate buffer, 7·5 ml. of KCl, 1·0 ml. of thymol solution were added and the solution made up to 50 ml. with water. The solution was transferred into the wider limb of the H-cell and purified hydrogen gas was bubbled through the solution for about 15 minutes to expel dissolved oxygen. The dropping mercury electrode was then placed in solution and drop time adjusted to 2-3 seconds. The applied voltage was set at $-0·5$ v (*vs.* SCE). The standard solution of the reagent was added from a micro burette (5·0 ml.). After each addition hydrogen gas was bubbled to mix the solutions. Current values were noted two minutes after stopping the hydrogen gas. Volume correction was applied to each of the current values recorded and plotted against the volume of the reagent added. The equivalence point was located by extrapolating the two branches of the curve. From the amount of reagent consumed by a definite amount of uranyl ions, the

composition of the precipitate at the equivalence point was calculated and was found to be metal to ligand as 3 : 2. The results in a series of titrations are reported in Table I. The ratio of metal to ligand shows that all the three –OH groups and the =CO group are involved in the complex formation.

TABLE I

Uranium (mg.)		Reagent consumed (mg.)	Ratio Uranium (gm. atoms) / Reagent (gm. moles)	Error (mg.)
Taken	Found			
2·380	2·365	1·708	1·499	−0·015
2·470	2·460	2·499	1·494	−0·010
4·760	4·818	3·456	1·483	+0·058
5·850	5·804	4·191	1·502	−0·046
7·141	7·139	5·121	1·500	−0·002
8·331	8·350	6·030	1·456	+0·019
9·456	9·548	6·848	1·455	+0·092
11·910	11·780	8·447	1·514	−0·130
14·290	14·450	10·370	1·464	+0·160

2·38 to 14·29 mg. of uranium can be estimated with an error of *ca.* 1%.

The author wishes to express his grateful thanks to Prof. K. Neelakantam for his interest and guidance in the work and to the C.S.I.R. for the award of a Junior Research Fellowship.

Department of Chemistry,   K. SYAMASUNDAR.
S.V. University College,
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OVARIAN RESPONSE TO CORPUS ALLATUM IN *IPHITA LIMBATA* STAL.

IT is well known that in insects two endocrine centres exercise their influence over several physiological activities. The prothoracic glands promote growth and differentiation leading on to the adult through their hormone called ecdysone, while the corpora allata secreting juvenile hormone (JH) influence the growth towards larval morphs during the growth phases.[1] The withdrawal of the juvenile hormone at the last moult leads to the realisation of the adult stage. However, JH gets produced again and this time growth and differentiation occur mainly in one special tissue, *viz.*, the gonads. Except in pædogenetic examples, reproduction occurs at a period when ecdysone is not available, as the thoracic glands which produce it degenerate soon after the emergence of the adult. Thus during the life of the insect JH is present in all stadia except at the period when metamorphosis occurs. The question here arises as to why the gonads which respond strongly to JH in the adult remains indifferent to growing titres of the same hormone in the larval stages.

We have investigated this problem in the female *Iphita limbata* (Hemiptera : Pyrrhocoridæ) by appropriate transplantations and extirpations. Ovaries from various stages were transplanted into hosts possessing various internal environments with reference to JH. The insects were all surface sterilized and the transfer of the explant was effected by means of a sterilized capillary pipette and in the hosts Penstrep (Merck Sharp and Dohme of India Limited) was applied at the wound before it was sealed off by means of paraffin at low melting point. Table I summarizes the findings of these *in vivo* studies.

These experiments prove that the ovary is not capable of responding to JH in the presence of ecdysone in the growing stages, but the action of a full dose of ecdysone alone in the absence of JH will initiate the formation and maturation of the oocytes and deposition of yolk in the ovary. The ovary is then able to continue its growth and eggs differentiate fully in the presence of JH. Once activated the ovary will respond to JH in any environment.

In *Iphita* the differentiation of ovary is characterized by the growth of eggs by deposition of yolk. The ovariole is of the telotrophic type, the eggs being connected to nurse cells by means of protoplasmic cords. This nutritive cord remains functional for a time until the egg has grown and migrated into the middle of the vitellarium, but later the egg becomes detached from the cord, and the more conspicuous growth in size occurs at this stage.[2] In our experiments it has been found that in *Iphita* the first stage of vitellogenesis proceeds uninterrupted in animals deprived of the corpora allata. But the second stage gets seriously affected by allatectomy and eggs often tend to get resorbed. In this context the influence of corpora allata in the second stage has been analysed further : transplantation of supernumerary corpora allata from adult mating females will bring about normal growth of eggs, while the glands from nymphal donors will only partly restore the formation of yolk.

It could be concluded that the ovary of *Iphita* will begin its differentiation only in the absence of JH, and once thus activated by a full dose of ecdysone alone at the late V instar stage, it

TABLE I

Expt. No.	Nature of the donor	Organ transplanted	*Host and condition of JH in hæmol, mpn	Result in the differentiation† of the ovary	Survival rate (%)
1	III instar	Ovary	All tectomized adult (No JH)	Negative‡	100
2	,,	,,	Early V instar (with little JH)	Negative	60
3	,,	,,	Late V instar (with no JH)	,,	60
4	1 Reclaimed	,,	IV instar (with JH)	,,	25
5	2 ,,	,,	,,	,,	25
6	3 ,,	,,	,,	Positive§	30
7	3 ,,	,,	Adult mating female (JH present)	Positive	80
8	Newly emerged adult female	,,	Any instar except late V (JH present)	,,	40
9	,,	,,	Late V instar (No JH)	Negative	70
10	Early V instar	,,	Mating female adult (with JH)	,,	90
11	Late V instar	,,	,,	Positive	100
12	III instar or IV instar	,,	,,	Negative	90

* V instar and adult hosts were ovariectomized prior to the introduction of the explant,

† Differentiation : Growth of the ovary, presence of the developing oocytes and presence of precursors of yolk and yolk droplets in processed sections

‡ No formation of oocytes and no yolk droplets,

§ Presence of developing oocytes, protoplasmic cord and presence of deposited yolk.

will respond to nymphal JH partly and to imaginal JH completely.

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HERMAPHRODITISM IN THE LIMPET *CELLANA RADIATA* (BORN) OF THE WALTAIR COAST

HERMAPHRODITISM in limpets appears to be a rare phenomenon. The previous records in the limpet, *Patella vulgata*, showed only a maximum of 1·2% hermaphrodites.[1] In the course of examination of the gonads of 2200 specimens of the common local limpet, *Cellana radiata*, collected from the 'intertidal zone, we came across a single hermaphrodite.

The observations were made on the limpets collected from the intertidal zone from the rocky outcrops in the local beach. Since there are no secondary sexual characters the gonad of the animal had to be examined before the sexes could be made out. The male gonad is yellow and the female violet brown in colour. The gonads were removed from the visceral mass and fixed in Bouin's fluid. Sections were cut

at 8 µ thickness and stained with Heidenhain's hæmatoxylin with eosin as counterstain.

The length of the shell in the hermaphrodite was 28 mm. Two separate gonads, an anterior grey and a posterior yellow, were present. The anterior and posterior gonads measured 4 mm. × 4 mm. and 8 mm. × 8 mm. respectively (Fig. 1). Histochemical observations revealed fully developed spermatozoa in the posterior gonad (Fig. 2) while in the anterior gonad both male and female elements were present (Fig. 3). The anterior gonad was predominantly female with full, medium and small-sized eggs and immature male elements. No intermixing of the male and female elements was noticed. The present hermaphrodite is a unique one because of the presence of separate male and hermaphrodite gonads.

Table I shows the distribution of sexes in 3 mm. size groups in 2,220 individuals of *Cellana radiata* (1,195 males and 1,025 females).

It is seen from Table I that both the sexes in *Cellana radiata* are equally distributed in all the size groups which suggests the absence of sex reversal. Observations on parasitised gonads indicated that parasitism in *Cellana* results only in the arrest of the gonadial development. Therefore in view of the absence of the influence of sex reversal and parasitism, hermaphroditism in *Cellana radiata* should have been caused accidentally. The present observation confirms the view of Dodd[2] who stated that in the limpet *Patella* sex change and parasitism are not the essential prerequisites for herma-

TABLE I

Sex	10–12	13–15	16–18	19–21	22–24	25–27	28–30	31–33	34–36
Male	34	146	235	3 8	214	142	87	25	4
Female	30	123	227	254	180	119	68	22	2
Total	64	269	462	562	394	261	155	47	6
Percentage of males in total	53·1	54·3	50·9	54·8	54·3	54·4	56·1	53·2	66·7
Percentage of females in total	46·9	45·7	49·1	45·2	45·7	45·6	43·9	46·8	33·3

F GS. 1–3. Animal after removal of foot showing the anterior hermaphrodite and posterior male gonads. Fig. 2. T.S. of male gonad showing seminiferous tubules packed fully with mature sperms. Fig. 3. T.S. of hermaphrodite gonad showing mature female and immature male elements. E = Eggs; Her = Hermaphrodite gonad; MG = Male gonad; S = Seminiferous tubules.

phroditism. He suggests that they are developmental mosaics with islands of heteroploid tissue.

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ON THE MULTIPLE EFFECTS OF OEDYMERISM IN THE MALES OF *NESOTHRIPS FALCATUS* ANANTHAKRISHNAN

The transition from the gynæcoid to the œdymerous condition in the males of several phlæophilous Tubulifera very often involves structural complexities, diverse growth patterns, unidirectional to multidirectional and producing simple or multiple effects, varying with species or species groups and leading to considerable difficulties in their determination (Ananthakrishnan, 1965, 1966, 1967). The extreme gynæcoid as well as the extreme œdymerous individuals at either end of a series therefore differ considerably in every respect, beyond recognition, the secondary sexual characters being totally lost in the extreme gynæcoid males and additional characteristics not known in the normal males, making their appearance in the maximum œdymerous forms.

Nesothrips falcatus Ananthakrishnan presents a remarkably striking picture of the multiple effects of œdymerism, involving the loss or reduction and development of several structures in the males. Besides the enlargement and elongation of the forefemora (128–224 μ) and shortening of the foretibia, the œdymerous males develop 2-3 very strong, stout, dark, chitinous, hook-like teeth at base on outer margin of the forefemora and along sides of forecoxæ; the apex of the foretibia dilates beyond normal and develops an asymmetrical tooth at apex in the maximum œdymerous forms; the foretarsal tooth reaches monstrous proportions from a small denticle 10–15 μ long in gynæcoid forms to a sabre-like condition 70–80 μ long in extreme œdymerous male. While in general the chætotaxy of the prothorax is normally unaffected and falls within a reasonable range in the gynæcoid-œdymerous condition, *Nesothrips falcatus* presents an unusual instance of varied development of the postoculars and prothoracic setæ, in particular the anteroangulars, which keeps pace with œdymerism, reaching a range of 50–160 μ long. The metanotum develops a median tongue-like process, lying on the pelta and also taking part

in the growth process, becoming highly vestigial or almost absent in the extreme gynæcoid male (10–15 μ) and very well developed (70 μ) in the maximum œdymerous individual.

FIG. 1. *Nesothrips falcatus* Ananthakrishnan. *a*, *b*, *c*, forelegs of gynæcoid, œdymerous and maximum œdymerous males; *d*, metanotal process of œdymerous male.

Minimum or extreme gynæcoid males, on the contrary, have weak, forefemora and foretibiæ with foretarsal tooth almost absent, without the strong chitinous armature of the forefemora and forecoxæ, reduced anteroangulars and other prothoracic setæ and postoculars and a vestigial metanotal spur.

Dept. of Zoology,   T. N. ANANTHAKRISHNAN.
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ON AN UNUSUALLY DENSE PHYTOPLANKTON 'BLOOM' AROUND MINICOY ISLAND (ARABIAN SEA), AND ITS EFFECT ON THE LOCAL TUNA FISHERIES

THE fishing season in this area for the tunas [chiefly *Katsuwonus pelamis* (L.)] by surface 'chumming' and angling during the months of February, March and April 1965, was fairly good. However, early in May 1965 the tuna catches suddenly fell off to nil. An investigation revealed that the seas around this island, which lies approximately 350 miles West off Trivandrum (Kerala State, India), were darkly discoloured a deep brownish hue to a distance of at least 35 miles around it (it was not thought advisable to venture further out in the tiny boat at my disposal) and the water itself had a distinct iodoform odour; a fine gritty film was found floating on the surface of the water, in vast sheets. The Secchi disc vanished at a depth of only 4 meters, indicating the density of the brownish suspended matter. Plankton samples were taken daily for the next few weeks till the water finally cleared up, and these samples revealed the presence of a diatomous alga *Trichodesmium erythrœum* Ehrenb., in great quantity.

Vast amounts of the odoriferous algal matter was also washed ashore along the fringing reef and the island proper during the period of study. The 'bloom' lasted till late June 1965. The boats caught nothing during all this time. The 'bloom' suddenly disappeared from the area in late June and the vessels immediately started getting good catches.

It was apparent that the tunas avoided the area due to the presence of *Trichodesmium*, returning only after the alga had disappeared; but whether this avoidance is due to mechanical. biochemical or other factors it is difficult to say, and remains yet to be studied.

A similar phenomenon in European waters was confirmed by Hardy[1] for the herring *Clupea harengus* L. on account of another alga *Rhizosolenia*. *Rhizosolenia* caused 'weedy water' or 'Dutchman's baccy juice', as skippers of fishing vessels named it. The exact reason for the avoidance by the fishes of the algal patches was not known.

However, Panikkar[2] has given details of mass mortality of fishes in the Arabian Sea between 1955–58, and observed that on the Indian coast the cause of the mortalities is the rapid increase

in population of the dinoflagellate, *Noctiluca* in particular, and the blue-green alga *Trichodesmium*; these occurred during the months of June, January and October between Longitudes 60° E. and 64° E, and Latitudes 9° N. and 22° N. chiefly: these being precisely the regions associated with upwelling and high productivity, but it remained to be established in every instance whether the mortality had been the result of the planktonic 'bloom' or of direct influence of upwelled oxygen-depleted water. He mentioned that the large-scale destruction of shoals of fish reported in the mid-Arabian Sea were more likely to be caused by the surfacing of oxygen-depleted water, as evidenced from the I.N.S. KISTNA data figures.

Minicoy Island lies between Lat. 8° 15′ N. and 8° 20′ N. and Long. 73° 0′ E. and 73° 4′ E., but no mortality (such as seems to be so characteristic in the case of upwelling of oxygen-depleted water) was to be seen, and it is more likely that the tunas completely avoided the area occupied by the algal 'bloom' due to some other reason.

I am thankful to Dr. R. Raghuprasad, C.M.F.R. Substation, Ernakulam, for help in identifying the alga.

Central Marine   A. K. NAGABHUSHANAM.*
    Fisheries Research Unit,
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BIOLOGICAL STAINING OF PRAWN, *METAPENAEUS AFFINIS*, TO STUDY MIGRATION

TAGGING of fish has been a common practice to estimate growth and fishing mortality, and to study migration from the returns of tagged specimens. In shrimps and prawns, although tagging has been tried,[1,2] the probable loss of tags, owing to frequent moulting, renders this method a distinct disadvantage. Application of the method of marking of animals by use of biological stains, has, therefore, been tried in shrimps.[3-6] Use of any of the biological stains for marking any prawn species in India has not so far, been undertaken.

Metapenaeus affinis constitutes a predominant prawn in the trawl catches off Southern Maharashtra, where prawn fishery has been considerably developed in the last five years.[7] Initially, laboratory staining techniques, by using Trypan Blue, Trypan Red and Fast Green, were tried on the live specimens and observations were made by maintaining injected specimens in glass aquaria. Trypan Blue was found to be the most suitable.

Marking of prawns with Trypan Blue was then undertaken at sea. On February 6th, 1967. 2,294 prawns were injected on board the research fishing vessel 'Varsha' and released into the sea at different places between 12 to 15 fathoms, ensuring that no concentration of marked prawns took at one place. On release, the prawns were seen on surface for a minute or so and then disappeared into the depths. To ensure return of marked specimens to the Research Station, wide publicity was given. The Government of Maharashtra declared a prize of Re. 1 for recovery of each marked prawn. Fishermen did not find it difficult to locate a stained prawn (Fig. 1) in the catch.

FIG. 1. Injected shrimp *M. affinis* showing branchial region stained.

During the following 30 days, 58 marked prawns were recovered through fishermen who recaptured these from different places as shown in Fig. 2; as many as 21 were taken off Ganapatipule, which is the most heavily fished area.

FIG. 2. Map showing recoveries of stained shrimps. The marked shrimps recaptured are indicated by numbers in the enclosed areas.

It is interesting to note that no prawn was captured south of the releasing centre. Returns of marked prawns seem to indicate that there is a northward migration of prawns during February to March. As no trawling is undertaken north of Jaigad, further extension of migration could not be located.

Record of the first recovery came off Jaigad on the sixth day after release, covering a distance of 18 nautical miles, giving an average rate of movement of three miles per day. Retention of Trypan Blue in the branchial region of prawn recaptured on the thirtieth day showed that the use of this stain is helpful in "tagging" or marking prawns on large scales as done in fishes. The details of this investigation are being published elsewhere.

I am indebted to Dr. C. V. Kulkarni, the Director of Fisheries, Maharashtra State, and Dr. H. G. Kewalramani for their encouragement

and guidance during the course of work. Thanks are also due to Shri S. N. Mahajan and the staff of R.V. 'Varsha' for their help in the field.

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KATROLAITES GEN. NOV., A NEW FOSSIL FROM THE JURASSIC ROCKS OF KUTCH, INDIA

THE present note deals with *Katrolaites* gen. nov., a new spore genus recovered from the Katrol shales (Jurassic) of Kutch, Gujarat, India. The shales are grey to buff in colour and were macerated with commercial nitric acid (60%) followed by hydrofluoric acid (40%). Potassium hydroxide (5%) solution was used for 3-4 minutes subsequently. The slides were prepared with polyvenyl alcohol and mounted in Canada balsam.

GENUS—*Katrolaites* GEN. NOV.

Type Species—*Katrolaites kutchensis* Gen. et Sp. Nov.

Generic Diagnosis.—Circular—sub-circular. Alete. Exine differentially thickened along equator; distally operculate, operculum mostly conspicuous.

Description.—Mostly circular, sometimes subcircular in polar view. Tetragonal compression mark sometimes present, but not accompanied by sutures (Fig. 4). Exine upto $4\,\mu$ thick, dense at equator and progressively thinning towards polar region; intrapunctate. Operculum on distal side, easily distinguishable. Exine radially folded along the margin of operculum.

Comparison.—*Exesipollenites* Balme (1957)[1] closely resembles the present genus in shape, differential thickening of the exine and absence of haptotypic mark. The former can, however, be distinguished by its presence of circular depression in the middle region and lævigate-granulose exine. *Spheropollenites* Couper (1958)[2] also approximates the present genus in shape, but can readily be distinguished by its

smaller size range and presence of depression (? pore) in the central region. *Distalanulisporites* Klaus (1960)[3] is roundly triangular in shape, possesses a distinct, well-developed trilete mark and a circular annulus in the middle. *Cooksonites* Pocock (1962)[4] is hilate and has a well-developed cingulum. *Coptospora* Dettmann (1963)[5] is as asymmetrically thickened along the equator and distinctly hilate while the present genus is operculate. *Classopollis* (Pflug) Pocock and Jansonius (1961)[6] and *Gliscopollis* Venkatachala (1966)[7] both possess equatorial tenuitas on the distal side borderning the operculum. *Granuloperculatipollis* Venkatachala and Goczan (1964)[8] is distinguished by the presence of the distal pore and the granulose ornamentation. *Katrolaites* proposed here is differentiated from all the known genera by its circular shape, more or less differentially thickened, lævigate and intrapunctate exine, absence of haptotypic mark and presence of an operculum in the distal polar region.

FIGS. 1-4. *Katrolaites kutchensis* gen. et sp. nov. Fig. 1. Holotype, note the distin t operculum and radial folds, *ca* × 500. Fig. 4. Note th tetragonal depression mark but not associated with suture, *ca.*, × 500.

Remarks.—Though closely comparable to *Coptospora* Dettmann (*l.c.*), the genus *Katrolaites* is readily distinguishable. Doubt may arise as to the nature of the opening (hilum) in *Coptospora*. It may be interpreted that by the detachment of the operculum in *Katrolaites* *Coptospora*-like forms can be resulted. The distal opening in *Coptospora* is mostly ill-defined, not confronting to any regular shape, while the operculum in *Katrolaites* is mostly

well defined and circular. We have not observed any spore with detached operculum.

Katrolaites kutchensis SP. NOV.

Holotype—Fig. 1. Size $64 \times 58 \mu$.

Type Locality.—Bandra, near Bhuj, Katrol Stage (Jurassic), Gujarat, India.

Specific Diagnosis.—Circular, $56-66 \mu$. Exine ± differentially thickened, lævigate and intrapunctate. Operculate, operculum on distal side, well defined.

Description.—Mostly circular, sometimes subcircular. Tetragonal mark present in some specimens. Exine $2-3 \mu$ thick, differentially thickened at the equatorial region. Operculum circular—subcircular, $30-38 \times 26-34 \mu$, mostly confronting with the general shape of the spores. Operculum intact, sometimes with small, radial folds on the proximal side.

Birbal Sahni Institute of   B. S. VENKATACHALA.
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ISOLATION OF MONOCROTALINE AND CRISPATINE FROM *CROTALARIA LECHNAULTII*

MONOCROTALINE occurs in several other species of Crotalaria while Crispatine has been reported so far only from *C. crispata*.[1]

A sample of the seeds assayed by the method of Culvenor and Smith[2] was found to contain $5 \cdot 25\%$ tertiary bases and $0 \cdot 67\%$ *N.* oxides. The dehusked powdered seeds of *C. lechnaultii* (300 g.) were defatted with *n*-hexane. The petroleum ether exhausted residue was further extracted with ethanol (95%) in a Soxhlet apparatus for 35 hours. The concentrated mass (60 g.) on TLC[3] using silica gel G and chloroform, methanol, ammonia (85 : 14 : 1) showed 3 spots R_f $0 \cdot 0$, $0 \cdot 32$, $0 \cdot 40$ and on paper chromatogram $0 \cdot 0$, $0 \cdot 43$, $0 \cdot 61$ (*n*-Butanol : 5% acetic acid, upper phase). The residue was triturated with dilute sulphuric acid (5% *v/v*) basified and extracted with chloroform. Removal of chloro-

form gave 15 g. of crude mixture of two alkaloids A and B (R$_f$ 0·32 and 0·40 respectively on TLC). The residual aqueous solution was acidified to pH 2, reduced with zinc dust, filtered, basified and extracted with chloroform which yielded additional quantities of mixture of A and B.

Attempts to isolate A and B by fractional crystallisation in different solvents failed. The crude mixture (3·5 g.) of A and B was dissolved in chloroform and applied to a column of neutral alumina (250 g. activity grade I) and by graded elutions yielded 1·5 g. B (Benzene), 0·3 g. A + B mixture (Benzene : Chloroform) and 1 g. if A (Chloroform : Ethanol).

Alkaloid A (R$_f$ 0·32) m.p. 195° (lit.[4] monocrotaline 196–197°), picrate m.p. 230° (lit.[4] 231°) and methiodide m.p. 205° (lit.[4] 205°). The alkaloid A was finally proved to be identical with monocrotaline by a mixed m.p. which was undepressed.

Alkaloid B m.f. 136° (lit.[4] crisyatine 137–38°). Elemental Analysis: Found C 61·0; H 7·6; N 4·6%, calculated for $C_{16}H_{23}O_5N$ (Crispatine) C 62·1; H 7·5; N 4·5%.

Alkaline hydrolysis of Alkaloid B was carried out with 2% sodium hydroxide at room temperature for 18 hours. The aqueous solution was extracted with ether to remove unhydrolysed base, acidified with dilute HCl and again extracted with ether. Acid ether extractions on evaporation and crystallisation from benzene gave colourless needles m.p. 133° (lit.[4] 133–34°).

The aqueous residue was evaporated to dryness in a vacuum desiccator. The crystalline residue on extraction with cold alcohol yielded necine–HCl m.p. 160° (after repeated crystallisation from acetone) undepressed on admixture with authentic retronecine hydrochloride.

The alkaloid B was finally proved to be identical with crispatine by comparison of IR spectrum.[4]

We are grateful to the Director, Central Drug Research Institute, Lucknow, for elemental analysis and IR spectra.

Regional Research Laboratory,   O. P. Suri.
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ON THE CHEMICAL INHIBITORS OF FUNGAL SPORES FROM THE SEEDCOATS OF THREE PLANT SPECIES

The presence of antimicrobial agents on the seedcoats of some plant species was reported by Bowen.[1] Thompson[2] reported that extracts of subterranean clover seedcoats contain a thermostable, water-soluble antibiotic which is inhibitory to a strain of *Rhizobium trifolii* Dangeard. Garber and Houston[3] reported the presence of an inhibitor to *Verticillium alboatrum* Rein. and Bert. in the seedcoats of both wilt-susceptible and wilt-resistant cotton varieties. The presence of such an inhibitor to the spores of *Helminthosporium oryzæ* Breda de Haan, the fungus causing leaf-spot disease of rice, in the seedcoats of sorghum, ragi and tomato is reported here.

One hundred seeds of each of the three plant species, viz., sorghum (*Sorghum vulgare* Pers.), ragi or finger millet (*Eleusine coracana* Gaertn.) and tomato (*Lycopersicon esculentum* Mill.) were surface sterilized with 0·1% mercuric chloride solution and washed in sterile distilled water. They were added separately to 100 ml. of sterile distilled water contained in 250 ml. Erlenmeyer flasks. The contents were shaken for 6 hr. on a wrist-action shaking machine. Then the suspension was filtered free from seed and other suspensions and the filtrate concentrated *in vacuo* to a final volume of about 5 ml. This concentrate, hereafter referred to as 'seedcoat leachate' was tested for its activity on the spores of *Helminthosporium oryzæ*.

One drop of the spore suspension in sterile distilled water of the fungus, obtained from the growth on oatmeal agar, was placed in the cavity of a microscope slide. To this a drop of the test chemical, i.e., the seedcoat leachate, was added. In the case of checks, additional drop of sterile water was added to the spore suspension in the cavity slide. The slides were incubated in moist chambers at room temperature (22-25° C.) and periodic observations were made. The germination per cent was calculated by examining 100 spores in each microscopic field and taking the average of 10 fields under each treatment. The results are presented in Table I.

There was not only delay in spore germination due to the chemicals, but also there was considerable inhibition of germination and germ-tube growth. The germ-tubes arising from the seedcoat leachate-treated fungal spores were invariably malformed, with characteristic

TABLE I

Effect of seedcoat leachate on the germination of spores of Helminthosporium oryzæ

Source of seed coat leachate	% germination of spores				
	12 hr.	24 hr.	48 hr.	72 hr.	96 hr.
Sorghum ..	0	0	0	2*	4*
Ragi ..	0	0	0	14*	12*
Tomato ..	0	0	0	18*	19*
Check (untreated) ..	80	98	..	.	..

* All the germ-tubes of the spores were malformed.

bulbous outgrowths, which got lysed within about 24 hr. after formation. The toxic substance(s) from the three seeds was found to be readily soluble in water, insoluble in most of the organic solvents tested, *viz.*, ethanol, chloroform, carbon tetrachloride, ether, *iso*-propanol and *n*-butanol, and was thermostable and active upto 100° C. Further studies on the antimicrobial activity of the chemical(s), its potency and biochemical properties are in progress.

That the presence of such antifungal substances on the seedcoats might serve as a defence mechanism against seed infection has been suggested by some workers.[4] In the present case the organism concerned is not a pathogen on any of the three plant seeds examined but is inhibited by the chemical(s) produced on the seeds. What would be the action of the chemical(s) on other pathogenic as well as non-pathogenic organisms needs investigation. An understanding of the biochemical and antimicrobial properties of the chemical(s) would help in exploring its usefulness in plant disease control as also in understanding the defence mechanism in the seeds against pathogens.

Division of Microbiology,   A. BALASUBRAMANIAN.
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SHOOT FORMATION FROM THE CALLUS TISSUE OF HORMONE-TREATED COWPEA LEAVES

COWPEA (*Vigna sinensis* Endl.) has been described as an indicator host of the pathogen which is suspected to cause the root (wilt) disease of coconut palm.[1] During the course of attempts to produce roots in detached trifoliate leaves of cowpea, using IAA, in order to employ them in studies connected with the root (wilt) disease of coconuts, it was observed that shoot primordia also began to develop from the callus tissues of the hormone-treated leaves (Fig. 1). The present note describes this interesting phenomenon.

FIG. 1. Development of shoot primordia from the base.

Two series of different concentrations of IAA, *viz.*, 10^{-2} M, 10^{-3} M, 10^{-4} M, 10^{-5} M, 10^{-6} M and 10^{-7} M were prepared, series I in glass-distilled water and series II in a nutrient solution.[2] Trifoliate leaves of 10-day old cowpea seedlings cut at the base of the petiole just above the region of the axillary bud, were first incubated at room temperature in small vials containing the solutions of series I, with the cut ends dipping in the fluid. Within 5 days of treatment, callus formation commenced at the cut ends of the petiole and roots were initiated. Three days later the hormone-treated leaves were transferred to small vials containing solutions of same concentrations of IAA in nutrient medium (series II) and were maintained as before. Forty-eight hours after they were transferred, shoot primordia developed from the callus tissue of leaves incubated in three concentrations of the solutions of series II, *viz.*, 10^{-5} M, 10^{-6} M and 10^{-7} M. After the initiation of shoots one set of treated leaves was transferred to 250 ml. conical flasks containing nutrient solution alone and another set, to mud pots containing garden soil. In both the sets the primordia developed into

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shoots and then into full-fledged plants
, 2). However as the new shoots deve-
d, the old trifoliate leaves slowly withered

G. 2. New plants developed from the shoot primordia—
the original leaf withering.

y. Although abundant root growth com-
ced in the trifoliate leaves treated with all
:entrations of IAA (series I), the leaves
ted with 10^{-2} M and 10^{-3} M concentrations of
turned yellow and died soon, probably due
he deleterious effect of the higher concen-
.ons of IAA translocated to the lamina
ugh the newly formed roots. The experi-
.t was repeated thrice when similar results
e obtained.

ud formation and shoot growth have been
rted earlier, in tissue culture studies using
. with parenchymatous cells of carrot.[3,4]
he present studies shoot growth has been ob-
ed without employing tissue culture methods.
Ve thank Dr. S. B. Lal, Director, for his
oful criticism and guidance during the course
his work.

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MEIOTIC STUDIES IN *RUNGIA REPENS* (LINN.) NEES

Rungia repens, a member of Acanthaceae, is a
spreading procumbent herb with lanceolate to
oblong elliptic leaves. The flowers are violet
or pinkish in erect terminal spikes. The plant
is commonly found at Delhi along the banks of
the Jamuna river.[1] The present note concerns
the meiotic behaviour of chromosomes and the
chromosome number count in *Rungia repens*
(Linn.) Nees.

The young flower-buds were fixed in Carnoy's
fluid (6 alcohol : 3 chloroform : 1 glacial acetic
acid) for half an hour and preserved in 70%
alcohol. The anthers were squashed in a drop
of 0·5% propionocarmine.

The pollen mother cells at prometaphase
showed 10 bivalents (Fig. 1). However, few
pollen mother cells showed early separation and
stickiness of the chromosomes during meta-
phase I and anaphase I (Figs. 2 and 3), respec-
tively. The distribution of chromosomes at
anaphase I was regular, 10 chromosomes being
present at each pole (Fig. 4). The second divi-

FIGS. 1–4. Fig. 1. Prometaphase showing 10 bivalents,
$\times$ 875. Fig. 2. Metaphase I showing $9_{II} + 2_I$, $\times$ 1,000.
Fig. 3. Early anaphase I showing stickiness of chromo-
somes, $\times$ 1,750. Fig. 4. Anaphase I showing equal
(10 : 10) distribution of chromosomes, $\times$ 1,450.

sional stages were quite normal. Our observa-
tions have revealed 10 as the haploid chromo-
some number for *Rungia repens*. It may be
mentioned that the somatic chromosome num-
ber for *Rungia pectinata* Nees has been recently
reported[2] as $2n = 50$.

Thanks are due to the Ministry of Education, Government of India, for granting a Research Training Scholarship to one of us (R. N. B.).

Department of Botany,   R. N. BHAT.
University of Delhi,   S. L. TANDON.
Delhi-7, *August* 12, 1967.

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OCCURRENCE OF *PHYMATOTRICHUM SYLVICOLUM* TAUBENHAUS AND WATKINS IN COFFEE ESTATES IN COORG

VERY frequently on dead shade trees and coffee bushes affected by a hitherto undetermined condition called 'Conancadoo Malady' in Coorg, a fungus was found growing either in the field or on incubated material *in vitro*.

The fungal mats appear as circular or irregular patches upto 3 cm. in diameter. They are cottony and white. The fungus on several occasions was found to be associated with an exosporous myxomycete, *viz.*, *Ceratiomyxa fruticulosa* (Müller) Macbride and very often it was indeed mistaken for this myxomycete in the field. The fungus was later on identified as *Phymatotrichum sylvicolum* Taubenhaus and Watkins.[1]

It is interesting to note here that recent reports of *Phymatotrichum sylvicolum* from South Africa[2] have also pointed out its association with the hyphomycete *Stilbella tomentosa* and a myxomycete *Trichia* sp. No attempt has been made to test the pathogenicity of *Phymatotrichum sylvicolum* on coffee.

The following is a brief description of a composite sample obtained from three different coffee estates in Coorg.

The hyphæ are cylindrical, septate, hyaline, with typical 'Rhozoctonia-like' branching in many cases. After more or less extensive elongation and ramification most of the lateral hyphæ eventually produce at their tips clusters of clavate or somewhat inflated finger-like branches. A group of such branches together with stalk comprise the conidiophore and the conidial production is not confined to the surface of the inflated tips but extends down for a considerable distance along the stalk.

The mature conidia are hyaline, one-celled, thin-walled, smooth, spherical measuring 2–4 (–5·5)µ with an average of 3·5 µ.

Phymatotrichum sylvicolum can be easily distinguished by its smaller conidia and the total absence of plectenchymatous mycelial strands that characterize *P. omnivorum*.

FIGS. 1–7. *Phymatotrichum sylvicolum* Taubenhaus and Watkins Fig. 1. Substrate mycelium. Figs. 2–4. Conidiophores. Fig. 5. Conidiophores tip with young developing conidia. Fig. 6. Conidiophore with mature conidia. Fig. 7. Detached, mature conidia.

Rallis India Limited,   V. AGNIHOTHRUDU.
Fertilizer and Pesticides Division,
P.O. Box No. 68, Bangalore-1,
August 18, 1967.

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SIMPLE METHOD FOR COUNTING ·EAF-HOPPER EGGS INSERTED IN PLANT TISSUE

cotton jassid *Empoasca lybica* (de Berg) he most important pest of cotton in the an Gezira. In the course of studies on the ies of *Empoasca* associated with cotton and r cultivated and wild host plants in the an, it was found necessary to obtain definite :mation on the behaviour of leaf-hopper ts in relation to oviposition sites and dis- ition of eggs on plants. A knowledge of exact position of eggs laid in plant tissue is to be lacking in many species of economi- important jassids.

me workers in the past had relied mostly ie presence of young nymphs on the leaves n index of the number of eggs laid and evidence has been taken as a basis for tal preference (Poos and Smith[1]). Evans[2] :ing on the cotton jassid in the Sudan a considered the distribution of immobile nymphal instars ('hatchlings') to deter- oviposition sites. He found that the est number of 'hatchlings' occurred in the e of the leaf veins and concluded that the are most frequently laid in this position ie newly expanded leaves.

rlson and Hibbs[3] described a satisfactory od for clearing *Solanum* leaves and directly :ing the number of eggs laid by the potato iopper *E. fabœ* (Harris).

the present studies various methods were to clear the leaves of chlorophyll. Caustic h solution (10%) was tried both cold and ι, but found not satisfactory. The leaves ed with KOH were soaked in cold phenol .on for a few minutes. The leaves thus ed were sufficiently transparent to locate eggs in the leaf tissue. Another method l quite satisfactory was the lactophenol ing method of Carlson and Hibbs which slightly modified. The solution consisted ie part each of glycerine, phenol, lactic (85%) and two parts of distilled water. ;olution was brought to boil and the leaves rsed for five minutes and then transferred

to cold phenol. When the treated leaves started drying in the course of examination, the eggs were clearly seen as small elongate, brownish dots. By using both the above-mentioned methods, jassid eggs—which are found laid in both lower and upper surfaces of leaves—could be counted without any difficulty.

Cowland[4] mentioned that the jassid eggs are laid embedded in the soft cortex of the leaf stems and main veins but not in the lamina of the leaf. The present studies have revealed that jassid eggs may be laid in the lamina of the leaf between two small veins, as well as in the main and secondary veins of the leaf. Also eggs were found inserted both on upper and lower surfaces of leaves, contrary to the belief of most workers on jassids.

FIG. 1. Photo showing leaf-hopper eggs inserted in the lamina of a castor leaf (lactophenol treated, × 5).

Leaves from various host plants were cleared to locate leaf-hopper eggs. The photo shows jassid eggs *in situ* inserted into the lamina in between two veins of the castor plant (*Ricinus communis*) which is one of the alternate host plants of leaf-hoppers in the Sudan.

Faculty of Agriculture,   WASSILA M. GADDOURA.
Univ. of Khartoum,   T. V. VENKATRAMAN.
August 12, 1967.

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REVIEWS AND NOTICES OF BOOKS

Relativistic Hydrodynamics and Magnetohydrodynamics—*Lectures on the Existence of Solutions.* By Andre Lichnerowicz. (W. A. Benjamin, Inc., New York and Amsterdam), 1967. Pp. ix + 196.

This informal research monograph is intended as a supplement to graduate courses in mathematical physics or applied mathematics. The author presents a new and complete mathematical study of the equations of motion for both charged and uncharged relativistic fluids.

The text begins with an introductory survey of the Leray theorems on hyperbolic partial derivative systems. Main applications are given to charged fluids with a null conductivity, and to the case of magnetohydrodynamics. Included is the first known existence theorem for the equations of magnetohydrodynamics. There is also a new approach to the theory of shock waves, as well as a report on new results in this field.   C. V. R.

Fundamentals of Quantum Mechanics—*Particles, Waves and Wave Mechanics.* By Sidney Borowitz. (W. A. Benjamin, Inc., One Park Ave., New York and Amsterdam), 1967. Pp. xiv + 401. Price $ 13.90.

This book is intended primarily as a one-year exposure to non-relativistic wave mechanics for senior students in college. A knowledge of calculus, elementary differential equations and vector analysis is presupposed. Beyond that, all of the mathematical techniques are developed as they are needed. The organization of the book and the selection of the preparatory material were dictated by the special problems associated with the presentation of the meaningful course at this level.

The subject-matter of this book has been dealt with under the following headings : 1. Waves and Particles ; 2. Wave Propagation ; 3. Fourier Series, Fourier Integrals, and Related Topics ; 4. Wave Propagation and Optics ; 5. Geometrical Optics—The Short Wavelength Limit ; 6. Dynamics ; 7. The Hamilton-Jacobi Theory of Dynamics ; 8. The Schrodinger Wave Equation ; 9. Solution of Some One-Dimensional Problems ; 10. Harmonic Oscillator ; 11. The Foundations of Wave Mechanics ; 12. Angular Momentum ; 13. The Hydrogen Atom ; 14. Perturbation Theory ; 15. Time-Dependent Perturbation Theory ; 16. Systems of Identical Particles.   C. V. R.

A Second Course in Complex Analysis. By William A. Veech. (W. A. Banjamin, Inc., One Park Ave., New York and Amsterdam), 1967. Pp. ix + 246. Price $ 8.75.

A clear, self-contained treatment of important areas in complex analysis, this senior-graduate level text is designed for a one-semester intermediate course.

The material is largely classical, with a few distinguishing features such as a detailed discussion of the prime number theorem. The Riemann mapping theorem is presented as a special case of an existence theorem for universal covering surfaces. Heavy emphasis is given to the geometry of complex mappings, particularly through frequent use of Schwarz's lemma. The universal covering surface of an arbitrary planar region is constructed, and the theorems of Landau, Schottky, Montel, and Picard are developed as consequences of the existence of certain coverings.   C. V. R.

Advances in Chromatography (Vol. 4). Edited by J. Calvin Giddings and Roy A. Keller. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1967. Pp. xiv + 380. Price $ 16.50.

Volume 4 of this well-known series contains the following articles : GENERAL CHROMATOGRAPHY : R_F Values in Thin-Layer Chromatography on Alumina and Silica, by Lloyd R. Snyder ; Steroid Separation and Analysis : The Techniques Appropriate to the Goal, by R. Neher ; Some Fundamentals of Ion-Exchange-Cellulose Design and Usage in Biochemistry, by C. S. Knight ; GAS CHROMATOGRAPHY : Adsorbents in Gas Chromatography, by A. V. Kiselev ; Packed Capillary Columns in Gas Chromatography, by Istvan Halasz and Erwin Heine ; Mass-Spectrometric Analysis of Gas-Chromatographic Eluents, by W. H. McFadden ; The Polarity of Stationary Liquid Phases in Gas Chromatography, by Lutz Rohrschneider.   C. V. R.

Conformation of Biopolymers (Vol. 1). Edited by G. N. Ramachandran. (Academic Press, London and New York), 1967. Pp. xiii + 425. Price 110 sh./$ 19.25.

This volume presents papers given by leading authorities at an international symposium on Conformation of Biopolymers held at the University of Madras, 1967. The contributions deal with theoretical and experimental studies on the conformational aspects of various polymers of biological significance such as proteins, polypeptides, nucleic acids and polysaccharides. Among the topics discussed are a wide variety of techniques used for study of conformational aspects of these macromolecules, including X-ray diffraction, infrared absorption, optical rotation and other physical and chemical methods.

This volume is an important record of recent research in the frontier field of biopolymers and will be welcomed by all biochemists working in this area and in particular by those who are interested in the conformational aspects of proteins, nucleic acids and polysaccharides and the relation between conformation and biological activity.   C. V. R.

Poly-α-Amino Acids (Vol. 1). Edited by Gerald D. Fasman. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1967. Pp. xv + 764. Price $ 34.50.

Poly-α-amino acids have become widely used models for the general study of the physical-chemical properties of proteins. Their importance in biological studies has also placed these polypeptides in a "sphere of influence" in modern biochemistry. Their synthesis, biological properties and physical-chemical behavior have aided in the interpretation of protein activity and conformation.

Emphasizing the physical-chemical aspects of poly-α-amino acids, this monograph reviews the extensive literature pertaining to the conformational analysis of these synthetic polypeptides, and presents a review of the current theory as to their stabilization factors and conformational determinants. It is of value to all students and research scientists interested in the problems of protein structure.

The titles of the chapters contained in this volume are as follows : 1. X-Ray Diffraction by Synthetic Polypeptides, by Arthur Elliott ; 2. Infrared Spectra and Helical Conformations, by Tatsuo Miyazawa ; 3. Dilute Solutions of Polypeptides : Light Scattering and Hydrodynamics, by Henri Benoit, Leon Freund, and Gerard Spach ; 4. X-Ray Diffraction Study of Polypeptide-Solvent Systems, by Pedro Saludjian and Vittorio Luzzati ; 5. Ultraviolet Absorption Spectra of Polypeptides, by W. B. Gratzer ; 6. Optical Rotatory Dispersion, by Jen Tsi Yang ; 7. Circular Dichroism of Poly-α-Amino Acids and Proteins, by Sherman Beychok ; 8. Hydrogen Exchange, by S. Walter Englander ; 9. Dielectric Properties of Polypeptides in Solution : A Physical Approach to the Chain Regularity of Biopolymers, by Akiyoshi Wada ; 10. Theory of Noncovalent Structure in Polyamino Acids, by Douglas Poland and Harold A. Scheraga ; 11. Factors Responsible for Conformational Stability, by Gerald D. Fasman ; 12. Biological Properties of Poly-α-Amino Acids, by H. Israel Silman and Michael Sela ; 13. Poly-L-Proline, by Leo Mandelkern.   C. V. R.

Soil Biochemistry. Edited by A. Douglas McLaren and George H. Peterson. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1967. Pp. xiii + 509. Price $ 22.75.

This book, written by leading international experts, presents the first analysis in English of recent research in soil biochemistry. It is a monograph in three parts : Isolation and Characterization of Soil Biochemicals, Metabolism of Soil Biochemicals, Soil Microbe Relationships, all combined in this one volume. The book outlines the approach to investigation of planetary soils, and includes biochemistry and biodegradation of herbicides and detergents, and microflora of the rhizosphere. Suitable as either a text or a reference, this work is valuable for researchers in soil science, soil microbiology and biochemistry, agricultural chemistry, plant nutrition, plant pathology, and microbial physiology, as well as all microbiologists.   C. V. R.

Experiments in Physical Chemistry (Second Edition). By David P. Shoemaker and Carl W. Garland. (Published by McGraw-Hill Book Company), 1967. Pp. 490.

This book provides a suitable text-book for a graduate-level laboratory course in physical chemistry. The first edition was well received. This second edition contains all of the experiments that were in the first edition with minor corrections and changes, and in addition there are three new experiments of a contemporary flavour, two concerned with chemical kinetics and one with the helix-coil transition in a polypeptide. Each experiment is accompanied

by a theoretical development in detail to provide a clear understanding of the method to be used, the calculations required and the significance of the final results. In addition to the experiments themselves (47 in number), there are several chapters of a general nature of importance in practical work, devoted to procedure, treatment of data, errors, apparatus and techniques.

The Decibel Notation (Second Edition). By V. V. L. Rao. (Published by Asia Publishing House, Calicut Street, Ballard Estate, Bombay-1), 1967. Pp. 211. Price Rs. 20.

The first edition of this book was published nearly two decades ago to meet the needs of the students of radio and acoustic engineering in decibel notation and its applications. The book is in three parts dealing respectively with "The Decibel", "Decibel Levels in Acoustics" and "Applications of Decibel Notation to Acoustics and Radio Engineering". This second edition, besides being a thorough revision of the first, contains additional matter, especially in Parts II and III, which together with the additions in the bibliography has brought the book up to date.

Problems of *in vitro* Culture. Edited by Angela E. R. Taylor. (Blackwell Scientific Publications Ltd., 5 Alfred Street, Oxford), 1967. Pp. 86. Price 27 sh. 6 d.

This little publication contains the papers presented at the Fifth Symposium of the British Society for Parasitology on "Problems of *in vitro* culture with special reference to parasitic organisms" held at the Zoological Society, London, on 18th November 1966. The six papers which form the contents include the principles of cell nutrition, the culture of rat and mouse embryos and *in vitro* cultivation and studies of parasites *Entomoeba, Hymenolepis nana, Trichinella spiralis,* and *Heamonchus contortus.*

Introduction to Parasitology. By Arthur W. Jones. (Addison-Wesley Publishing Company, Inc., 10-15, Chitty Street, London W. 1), 1967. Pp. 458. Price $ 10.75.

In today's world the subject of parasitology has become one of profound human interest. International agencies, such as WHO, are placing money and personnel at the disposal of

underdeveloped countries of the tropics to the eradication of malaria and to the study of such other parasitological diseases as trypanosomiasis, schistosomiasis, and hookworm. In this context the present publication with its clearly written text and instructive illustrations will appeal not only to students and teachers of the subject but also to the laymen as well.

The book is intended to provide a short course on parasitology included in the curricula of the students of biology, medicine or veterinary science. The non-parasitologists also can learn many interesting facts about major health problems caused by parasites, about the evolutionary ingenuity of these animals to adapt themselves to a parasitic way of life, about the ecological and physiological factors affecting their development, etc.

The clear and systematic treatment serves to introduce to the reader basic ideas in parasitology. The parasites are arranged according to their places in the animal kingdom beginning with the Protozoa. Each major group is discussed in an introductory chapter which is followed by a series of chapters on specific diseases, immunity, treatment, control, and eradication. The illustrations, drawn by the author's artist brother Allen D. Jones, add interest and value to the book.   A. S. G.

Methods in Computational Physics (Vol. 6)— *Nuclear Physics—Advances in Research and Applications.* Edited by Berni Alder, Sidney Fernbach, Manuel Rotenberg. (Academic Press, New York), 1967. Pp. xiv + 303. Price $ 13.50.

The Schroedinger equation can be solved analytically in only a few special cases. For this reason, it has been necessary to construct models which approximate the energy spectra and the first few moments of the density distribution in nuclei. It is here that the digital computer comes of help whereby a quantitative check with experiment is possible for the various complex models, that theoreticians may postulate.

The present volume on *Methods in Computational Physics* deals in six chapters the computational aspects of the following models of the nucleus : The optical model ; the Bruechner many-body theory of finite nuclei ; the Hartree-Fock model ; the Monte-Carlo technique ; the nuclear shellmodel ; nucleon-nucleon phase by shift analysis.   A. S. G.

A NEW SYNTHESIS OF ISOELLIPTOLISOFLAVONE AND SYNTHESIS OF ISOELLIPTIC ACID

V. CHANDRASHEKAR, M. KRISHNAMURTI and T. R. SESHADRI

Department of Chemistry, University of Delhi, Delhi-7

IN an earlier publication[1] a new approach to the synthesis of rotenoids was described and was illustrated by the synthesis of munduserone and elliptone. Erosone, isolated as a minor component from the seeds of *Pachyrrhizus erosus* (yam beans), has been suggested[2] the structure (I) which is closely related to that of elliptone (II) and is its linear isomer. The key intermediate required for its synthesis is iso-elliptolisoflavone (III). The synthesis of a furano-isoflavone of this type is not possible from a 7-hydroxyisoflavone because the methods available for the construction of a furan ring on it lead only to the synthesis of an angularly fused compound. Therefore, we have now used the procedure adopted by Seshadri and Sood[3] for the synthesis of psoralen (IV) in which the required migration of an allyl group is effected in the ketone stage itself as described below.

I   II

III   IV

lead only to the synthesis of an angularly fused oxyphenyl-2, 4, 5-trimethoxybenzylketone (V)[1] was the starting point. It was methylated to (VI), m.p. 105–106°, and subjected to Claisen migration. The allyl group migrates to the position para to methoxyl to yield the 5-allyl-

V,   R = R″ = H ;   R′ = Allyl

VI,   R = CH₃ ;   R′ = Allyl ;   R″ = H

VII,   R = CH₃ ;   R′ = H ;   R″ = Allyl

VIII,   R = R′ = H ;   R″ = Allyl

IX   X

desoxybenzoin (VII), m.p. 146–147°. Subsequent partial demethylation with aluminium chloride

in acetonitrile yielded the ketone (VIII), m.p. 170–171°, which underwent cyclisation to form 7-hydroxy-6-allyl-2′, 4′, 5′-trimethoxyisoflavone (IX), m.p. 262°. On treatment with osmium tetraoxide followed by sodium metaperiodate and subsequent ring closure with polyphosphoric acid it gave isoelliptolisoflavone, m.p. 191°, which was found to be identical (mixed m.p. and U.V. spectra) with an authentic sample supplied by Dr. Fukui who obtained it by a different route starting from (X).[4] The present method is far more convenient.

Isoelliptolisoflavone smoothly underwent partial demethylation at the 2′-position with aluminium chloride in acetonitrile to yield the 2′-hydroxy compound (XI), m.p. 200–201°, which on refluxing with bromoacetic ester in acetone solution in the presence of potassium carbonate gave the 2′-carbomethoxymethoxyiso-flavone (XII), m.p. 138–140°. This intermediate on alkaline degradation opened the oxygen ring and gave isoelliptic acid (XIII), m.p. 193–194°.

XI, R = H

XII, R = CH₂·CO₂C₂H₅

XIII

The melting point of the synthetic acid is different from that reported (204°) for the acid obtained by the degradation of dehydroerosone. A direct comparison with an authentic sample was not possible since it is not obtainable from any of those who handled erosone. Therefore, yam beans (500 g.) obtained from Calcutta were extracted to isolate erosone which could be degraded to the desired acid. The sample, however, did not yield erosone; four other compounds were obtained. Three of these were major components and were identified as pachyrrhizin, erosnin and dehydroneotenone; the fourth was very small and appeared to be dolineone. Further work on fresh samples of beans and on the conversion of isoelliptic acid into the rotenoid are in progress.

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VIBRATIONAL SPECTRUM OF ACENAPHTHENEQUINONE

S. NATH SINGH, M. G. JAYSWAL AND R. S. SINGH

Department of Spectroscopy, Banaras Hindu University, Varanasi-5

UNLIKE those of other p-quinones studied under our present programme in this Laboratory,[1-3] the two C=O groups in acenaphthenequinone molecule are not directly conjugated with the aromatic ring. Therefore, it will be more interesting to study the electronic and vibrational spectra of this molecule. The present communication records the infra-red spectrum of the compound in the region 650–4000 cm.⁻¹ and the frequencies observed have been assigned to different modes of vibrations along with those from the Laser trace of the Raman spectrum. As regards the previous work on the vibrational spectrum of this molecule, only C=O stretching vibration has been discussed by some authors[4-6] both theoretically and experimentally.

The Eastman L.R. grade sample of acenaphthenequinone was sublimed before use and yellow needles were obtained. The infra-red spectrum was recorded with a Perkin-Elmer Spectrophotometer (Model 221) equipped with NaCl optics employing KBr technique. The concentration of the compound was varied between 1% and 2·5% in KBr. A typical trace of the infra-red spectrum of the compound is shown in Fig. 1. The Raman spectrum of the compound was recorded by Haber in Cary Instruments Laboratory, California, on the model 81 Raman spectrophotometer with a Ne-He laser source.

The acenaphthenequinone molecule has been assumed to be planar one, belonging to the C_{2v} point group. The Z-axis is taken as the twofold axis of symmetry and Z, Y as the plane of the ring. The fifty-four normal modes of vibrations of the molecule are divided into symmetry species $19a_1 + 8a_2 + 9b_1 + 18b_2$. The vibrations of species a_1, b_1 and b_2 are active in infra-red while all the fifty-four vibrations are Raman active. The assignments of various frequencies have been mostly been done on the basis of intensity considerations and position of observed frequencies. Further support has been sought from the vibrational assignments of acenaphthene,[7] naphthalene,[8] p-benzoquinone[9] and 1, 4-naphthoquinone.[10]

The assignments of the frequencies observed both in the Raman and infra-red spectra are shown in Table I. The frequencies 1724 and 1780 cm.⁻¹ assigned to C=O stretching mode of vibrations indicate the unsymmetrical association

of the two C=O groups to the aromatic ring.[5] The magnitude of these frequencies shows aliphatic character of the substituted group and the molecule has been characterised not as a 'true quinone'.[11]

TABLE I

Vibrational assignments of the observed infra-red and Raman frequencies

Raman (solid) cm.⁻¹	(Int.)	Infra-red (solid) cm.⁻¹	(Int.)		Assignments
172	(2)	..	..	a_2	C=O bending o.p. ?
153	(3)	..	..	b_2	wing wagging o.p.
194	(1)	..	..	b_2	C=O bending o.p.
276	(2)	..	..	a_2	skeletal distortion o.p.
300	(3)	..	..	a_2	,,
391	(½)	..	..	b_2	,,
412	(1½)	..	..	b_1	C=O bending i.p.
470	(4)	..	..	a_1	skeletal distortion i.p.
519	(1½)	..	..	b_2	,,
575	(7)	..	..	a_1	,,
..	..	673	(½)	A_1	153+519=672
..	..	684	(2)	b_2	skeletal distortion i.p.
..	..	725	(½)	B_2	153+575=728
..	..	742	(1)	b_1	skeletal distortion o.p.
790	(5)	780	(9)	a_1	ring breathing
..	..	795	(1½)	b_2	C—H bending o.p
835	(1)	832	(8)	b_1	,,
..	..	898	(7)	b_1	,,
920	(5)	923	(1)	b_1	,,
933	(½)	..	..	A_2	412+519=931
..	..	942	(1½)	b_1	C—H bending o.p.
990	(½)	985	(1½)	a_1	C—H bending i.p.
1013	(2)	1014	(8)	b_2	,,
1058	(2½)	1058	(4)	a_1	,,
1105	(1)	1105	(1½)	b_2	C—C stretching (in substituted group)
..	..	1145	(sh)	A_1	2×575=1150
1150	(1)	1151	(3½)	a_1	C—H bending i.p.
1178	(1½)	1180	(1)	a_1	,,
1210	(½)	1213	(6)	b_2	,,
..	..	1247	(2½)	a_1	C—C stretching
1275	(1)	1277	(9)	b_2	,,
1350	(1½)	1347	(2)	a_1	,,
..	..	1382	(1)	a_1	,,
1403	(1)	..	..	A_2	194+1213=1407
1418	(4)	1420	(5)	a_1	C—C stretching
1436	(6)	1436	(4)	a_1	
1447	(1)	1445	(sh)	B_2	391+1058=1449
1485	(½)	1483	(4½)	b_2	C—C stretching
1586	(6)	1590	(7½)	b_2	,,
1593	(4½)	1594	(8½)	a_1	,
1605	(4)	1607	(2)	a_1	
1639	(2½)	..	..	A_1	742+898=1640
..	..	1685	(sh)	A_1	795+898=1693
1723	(10)	1724	(10)	a_1	C=O stretching
1735	(2)	1737	(sh)	A_1	575+1151=1726

FIG. 1.   Infrared spectrum of Acenapthenequinone.

TABLE I—*Contd.*

Raman (solid) cm.$^{-1}$	(Int.)	Infrared (solid) cm.$^{-1}$	(Int.)	Assignments	
1780	(2½)	1780	(2½)	a_1	C = O stretching
..	..	1910	(2)	A_1	$470 + 1436 = 1906$
..	..	1973	(2)	A_1	$2 \times 985 = 1970$
2228	(½)	..	..	A_2	$742 + 1483 = 2225$
..	..	2840	(½)	A_1	$2 \times 1720 = 2840$
..	..	2938	(1)	a_1	C—H stretching in CH$_2$ group
3030	(1)	3028	(½)	a_1	C—H stretching
3056	(1)	3065	(2)	a_1	,,
3075	(4)	3076	(1)	b_2	,,
3090	(1)	3105	(½)	B_2	$1483 + 1607 = 3090$
..	..	3440	(2½)	A_1	$2 \times 1723 = 3446$

i.p. – in plane, o.p.– out of plane, sh – shoulder

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EFFECT OF CERTAIN ALKYLATING AND NON-ALKYLATING CHEMOSTERILANTS ON *CULEX FATIGANS* WEID

K. K. GROVER, M. K. K. PILLAI AND C. M. S. DASS

Department of Zoology, University of Delhi, Delhi-7

THE successful eradication of the screw-worm fly, *Cochliomyla hominivorax* (Coquerel) has demonstrated for the first time the potential possibilities of using the sterility principle in controlling noxious insects.[1] Sterility has been achieved by using (*a*) gamma or X-ray irradiation and (*b*) chemosterilants and the latter are found to be more advantageous.[2] These are mainly alkylating aziridine compounds and their effect has been tested on house-flies and mosquitoes.[3,4] This paper is a report on the toxicity and sterilizing effectiveness of some of the alkylating and non-alkylating chemosterilants against *Culex fatigans*.

MATERIALS AND METHOD

The following chemosterilants were used :—

A. *Alkylating agents*:

1. Tepa—Tris (1-aziridinyl) phosphine oxide.

2. Metepa—Tris [1-(2-methylaziridinyl)] phosphineoxide.

3. Apholate—2, 2, 4, 4, 6, 6-hexahydro-2, 2, 4, 4, 6, 6-hexakis.

4. (1-aziridinyl)-1, 3, 5, 2, 4, 6-triazatriphosphorine.

B. *Non-alkylating agents* :

4. Hempa—Hexamethyl phosphoramide.

5. Hemel hydrochloride—Hexamethyl melamine hydrochloride.

Two separate series of experiments were performed by exposing the larvæ and pupæ of *C. fatigans* to these various chemosterilants. The mosquitoes used in this study originated from a strain of *C. fatigans* collected from the fields near Delhi in October 1965 and since maintained in the insectary at 80° F and 80% R.H. For larval treatment 200 early second instar larvæ were exposed to 500 ml. of given chemosterilant of desired concentration dissolved in distilled water (ppm). The larvæ during treatment were fed on a mixture of brewer's yeast and blood albumen (10 : 1). At the time of pupation the larvæ were removed from the treating medium and washed in distilled water and transferred to separate vials for emergence. Ten emerged females and ten males were released into wooden frame cages. Females were given pigeon blood meal on alternate days. Egg rafts were collected for two weeks and were studied for fecundity and hatchability by counting the number of eggs and the emerged larvæ.

Newly formed pupæ of the stock strain were used for pupal treatment and the same procedure as described above was followed except that the duration of exposure to chemosterilants was only for 28 hours.

Controls for both types of treatments using same number of larvæ and pupæ were run concurrently. Mortality at all stages during treatment is taken into account to calculate percentage mortality.

Results and Discussion

The toxicity of the various chemosterilants and their effect on oviposition and sterility are given in Table I. In larval treatment all the chemosterilants used at 10 ppm did not prove to be toxic. However, hemel was found to produce high mortality at 25 ppm while hempa was toxic only at very high concentration, viz., 250 ppm.

Pupæ treated with hemel at 10,000 ppm caused 75% mortality. Among other chemo-

sterilants tepa was found to be more toxic to pupæ while apholate and hempa were equitoxic. Only metepa was found to be relatively safe showing only 8% mortality. Mortality in all these cases occurred at the critical moulting period. Higher doses of chemosterilants induced various types of structural abnormalities.

TABLE I
Effect of various chemosterilants on the mortality, oviposition and egg hatch of C. fatigans

Chemosterilant		Conc. in ppm.	Mortality %	No. of eggs rafts	No. eggs	% hatch
A. Larval treatment :						
Apholate	..	10	2·0	11	743	0·7
Metepa	..	1	0	14	2130	95·0
		5	3·0	13	1908	90·0
		10	3·0	9	990	75·4
Tepa	..	10	0	11	1172	50·4
Hemel	..	10	12·0	22	2778	90·5
		25	35·0	9	1341	54·7
Hempa	..	10	2·0	10	1886	52·0
		100	2·0	8	882	50·0
		250	58·0	4	328	1·8
		500	78·0	0	0	0
Control	..	..	..	14	2135	95·1
		..	..	13	2288	96·6
		..	..	14	2160	92·2
		..	..	15	1908	90·2
B. Pupal treatment :						
Apholate	..	1,000	0	10	1694	61·6
		5,000	30·0	5	972	22·7
		10,000	38·0	9	1438	9·9
Tepa	..	1,000	0	11	1611	62·5
		5,000	3·0	7	1152	6·9
		10,000	58·0	0	0	0
Metepa	..	500	0	16	1842	81·5
		1,000	0	14	2974	72·4
		5,000	4·0	8	1348	64·3
		10,000	8·0	10	1646	4·9
Hemel	..	10,000	75·0	8	1256	66·4
Hempa	..	10,000	34·0	11	1739	82·6
Control	..	..	..	13	2226	90·1
		..	..	13	2471	89·6
		..	..	12	2147	96·6

Apholate was found to lower oviposition and to cause about 100% sterility with 10 ppm in larval treatment. Though tepa did not produce marked decrease in oviposition rate as apholate, it induced about 50% sterility at the same dosage. On the contrary, metepa produced marked decrease in oviposition but could not induce significant sterility even at 10 ppm. Hempa was found to be better than tepa with 10 ppm in inducing a high percentage of sterility

and with increase in dosage it lowered the oviposition rate and could produce 100% sterility. Hemel induced only about 26% sterility at 25 ppm.

In pupal treatment tepa produced 100% sterility with 10,000 ppm whereas metepa and apholate at the same concentration induced only 95% and 90% sterility respectively. The lower concentrations of tepa, apholate and metepa also proved to be quite effective in inducing considerable sterility (5,000 ppm). Hemel, though highly toxic, was found to be better than hempa against pupal treatment.

In larval treatment apholate proved to be the best as it shows least toxic effect and causes maximum sterility. In *C.p. quinquefasciatus* Mulla[2] has shown similar effect of apholate, metepa and tepa in larval treatment. The effectiveness of aziridine compounds such as tepa, metepa and apholate were to be expected as they are not greatly species specific. The activity of hempa and hemel on the larvæ is most interesting ; as non-alkylating chemosterilants they are quite specific in their activity against *C. fatigans.*

Pupal treatment is more advantageous as pupæ can tolerate very high concentration of chemosterilant and also selective treatment of males and females at this stage is possible. At higher dosage all the chemicals showed an appreciable toxicity. One useful feature observed in pupal treatment is that the oviposition rate was not decreased as much as in the case of larval treatment. The high effectiveness of tepa against pupæ cannot be accounted on the basis of its structure. It has been pointed out that there is no correlation between the number of aziridine rings and the decrease or increase in their sterilising capacity.[5] However, the present data clearly indicate that the activity of a chemosterilant against one instar is different compared to that on other instars of the same insect as shown in case of metepa and tepa where pupal treatment is considerably more effective than larval treatment. Derivatives of aziridines as chemosterilants seem to affect the genetic material of the organism producing dominant lethal mutations that render them sterile.[6] The exact mode of action of these alkylating and non-alkylating chemosterilants are yet to be elucidated.

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SOME NEW OBSERVATIONS ON PHLOEM IN *LUFFA CYLINDRICA* (L.) ROEM.

J. J. SHAH AND RAJU JACOB

Department of Botany, Sardar Patel University, Vallabh Vidyanagar, Gujarat

THOUGH much work has been done recently in the study of phloem, many details regarding the structure of a mature sieve-tube element remain unsettled. Some points of disagreement are the nature of slime, its relationship with the cytoplasm, location of cell contents and their nature in a mature uninjured sieve-tube element. It is generally accepted that the central cavity of a mature sieve-tube element is filled with some contents, though controversy regarding their nature persists. According to Duloy, Mercer and Rathgeber,[1] a mature sieve-tube element is without any cytoplasm and its walls are lined with a parietal layer which surrounds dispersed fibrils of slime present in the lumen. According to Kollmann[2] the slime is specific cytoplasmic differentiation, rather than a final product of metabolism. Hence the whole contents of a mature sieve-tube element are cytoplasmic. Engleman[3] believes that fibrillar and/or amorphous slime is present along with other cytoplasmic materials in the sieve-tube element. Several other workers[4-5] believe that sieve-tube elements contain internal strands, which traverse through the sieve plates of consecutive elements, though their interpretations regarding the nature are varying. During the course of our investigation

on the phloem in the petiole of *Luffa cylindrica*, we have observed certain mature sieve-tube elements with peripheral cytoplasm and slime and specialized parenchyma cells with extruded nucleoli and callose deposition on lateral as well as end walls.

are disturbed in the sectioned material ("A" in Figs. 1-4). A number of strands of varying thickness are longitudinally and transversely placed in the peripheral contents. The contents of the sieve tube element appear occasionally withdrawn from the lateral walls.

FIGS. 1-7. Figs. 1-4. Mature sieve tube elements illustrating peripheral contents and a central cavity. A-region where central cavity is exposed. Rupture of the peripheral contents is also evident. Figs. 5-7. Specialized parenchyma cells. Fig. 5. A specialized parenchyma cell showing vacuoles, enlarged nucleoli, and chloroplasts at early stages of their disorganization.; Fig. 6. Illustrates the extruded nucleolus (unlabelled arrow) and nucleus with scanty contents. The disorganizing chloroplasts are grouped at B; Fig. 7. A specialized parenchyma cell showing callose deposition at the lateral and end walls (unlabelled arrows). All, × 966.

Figures 1-4 illustrate the peripheral contents of the sieve-tube elements. The mature sieve plates have scanty callose. Sieve areas are also present on the lateral walls. The peripheral contents are present surrounding a central cavity. This cavity is exposed at a number of places where the peripheral contents

Many workers believe that as the sieve-tube element matures, the breakdown of the tonoplast allows the contents of the vacuole to mix up with the cytoplasm and the lumen is filled with vacuolar fluid, slime and cytoplasmic material. Engleman coined a new term "micto-plasm" for this mixture. Evert *et al.*[8] believe

that cytoplasmic slime is probably the only substance of cytoplasmic origin in the central cavity of the mature sieve-tube elements and is present in the form of continuous strands through the sieve plates. Thaine[6] depicts the strands in mature sieve-tube elements as cytoplasmic and names them as "transcellular strands". On the basis of its response to the bromphenol blue test[9] for proteins, we believe that the strands observed in *Luffa* are of slime.

The presence of a central cavity apparently without any mixing up of peripheral cytoplasmic contents is new to phloem study. Recently similar observations have been encountered in mature sieve-tube elements of a number of woody dictoyledons by Professor Evert (personal communication). We could not observe any membraneous system delimiting the central cavity and the peripheral contents in *Luffa*. But there are reports of a tonoplast in a mature sieve-tube element also. Schumacher and Kollmann[10] and Kollmann[11] have reported tonoplast in a mature sieve-tube element of *Passiflora*. Though a distinct tonoplast is not present in *Cucurbita*[8] and *Primula,*[12] it is believed that a delimiting membrane between parietal layer of cytoplasm and the central cavity is present in the mature sieve-tube elements.

The specialized type of phloem parenchyma cell observed in *Luffa* has the following features :

(1) The cell is generally associated with the sieve-tube elements of inner and outer phloem. It is shorter or longer or rarely equal in length with the associated sieve-tube elements.

(2) The cell in its early ontogeny resembles a normal parenchyma cell having a large nucleus with one or more nucleoli, vacuoles with tonoplast and chloroplasts. The cell wall is thick or thin with primordial pits.

(3) During the early stage of specialization the nucleoli enlarge (Fig. 5), later extrude out and lie in the cytoplasm (unlabelled arrow in Fig. 6).

(4) Simultaneously chloroplasts group together and show signs of disorganization by losing their shape, size and avidity for staining ("B" in Fig. 6). The vacuoles are not discernible. The nucleus shows less contents.

(5) The cell at this stage shows callose deposition at primordial pits on lateral as well as end walls (unlabelled arrows in Fig. 7).

(6) Most of these cells ultimately obliterate with the associated sieve-tube elements.

Specialized parenchyma cells intergrade between companion cells and ordinary parenchyma cells in primary as well as secondary phloem of dicotyledons.[13-16] Cheadle and Esau[16] distinguished the specialized parenchyma cells as ontogenetically related to the sieve-tube elements. In *Luffa* this point requires further study. The specialized parenchyma cells of *Luffa* show a feature distinguishing it from all the other similar types reported so far, in exhibiting the extruded nucleolus. The extrusion of the nucleolus, nucleus with scanty contents, deposition of callose and distintegration of chloroplasts are features of morphologic and physiologic specialization, indicative of stages of differentiation of a sieve element.

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LETTERS TO THE EDITOR

ANISOTROPY OF THERMAL EXPANSION OF ZINC OXIDE

Wurzite (ZnS) is hexagonal and it is known[1] that In this structure the inter-atomic binding in the 'c' direction is stronger than that in the 'a' direction. As a consequence of this anisotropy in binding, the thermal expansion in the 'c' direction (a_c) is expected[1,2] to be less than that in the 'a' direction (a_a). It can be seen from the data given in Table I that this is true for wurzite and two other isomorphous crystals, CdS and BeO. Zinc oxide also has the same structure. There are three reports regarding the thermal expansion of ZnO. Data from these reports are given in the Table. It is found that the anisotropy is different in the data given by Fizeau[6] and by Beals and Cook.[7] If we consider the volume expansion ($2a_a + a_c$), it is seen that the value from Wooster's[1] data is higher than the value from Fizeau's[6] data by nearly 100%. In view of this situation a re-determination of the thermal expansion of ZnO was considered desirable. The present note reports the results of an X-ray measurement of the thermal expansion of zinc oxide.

TABLE I

Crystal	$a_a \times 10^6$	$a_c \times 10^6$	Ref.
ZnS	6·54	4·59	3
CdS	6	4	4
BeO	7·5	6·3	5
ZnO	3·2	3·9	6
	6·9	5·9	1
	5·85	5·25	7

Pure quality zinc oxide powder was used for the work. X-ray photographs were obtained with Cu radiation on a symmetric focusing camera designed by Sirdeshmukh.[8] Four high-angle reflections were used to evaluate the lattice parameters. The evaluation of lattice parameters was carried out by using a procedure similar to that employed by Taylor and Floyd.[9] The lattice parameters were obtained at 25° C. and 196° C. The coefficients of thermal expansion evaluated from the lattice parameters are given below.

$$a_a = \left(\frac{1}{a_{25}}\right)\left(\frac{\triangle a}{\triangle t}\right) = 6\cdot5 \times 10^{-6}/° C.$$

$$a_c = \left(\frac{1}{c_{25}}\right)\left(\frac{\triangle c}{\triangle t}\right) = 3\cdot2 \times 10^{-6}/° C.$$

The anisotropy of thermal expansion of ZnO is thus similar to that observed in ZnS, CdS and BeO. We may therefore conclude that in crystals with the wurzite structure a_a is higher than a_c.

Physics Department,   D. B. Sirdeshmukh.
Osmania University,   V. T. Deshpande.
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INFRARED SPECTRUM OF SALICYLALDEHYDE

The infrared absorption spectrum of salicylaldehyde was recorded on Perkin Elmer Infrared Spectrophotometer (Model 13 U) equipped with NaCl optics. The thickness of the liquid cell used was 0·05 mm. The spectrum lies in the region 700–4500 cm.$^{-1}$ and consists of more than 30 bands. The accuracy of the measurements is about $\pm$ 2 cm.$^{-1}$ in the region 700–1500 cm.$^{-1}$, $\pm$ 4 cm.$^{-1}$ in the region 1500–2000 cm.$^{-1}$, and $\pm$ 10 cm.$^{-1}$ in the region 2000–3000 cm.$^{-1}$,

Salicylaldehyde molecule in which CHO and OH groups lie in 1 and 2 positions of the benzene ring may be assigned to C_s point group with the plane of the molecule as the only symmetry element. Taking CHO and OH groups to be single particles, the number of normal vibrations comes to be 30, out of which 21 vibrations belong to a' species and 9 vibrations to a'' species. Along with these vibrations the substituent sensitive vibrations have also been observed. All these vibrational frequencies with their mode of vibrations are included in Table I.

TABLE I
Vibrational frequencies and their assignments of salicylaldehyde molecule

Infrared Frequencies		Assignments	
149*	(5 b)	a''	C—OH twisting
265*	(3)	a''	C—CHO o.p. bending
408*	(2)	a''	C—C—C o.p. bending
449.*(5)			..
561*	(4)	a'	C—CHO i.p. bending
663*	(1)	a'	C—C—C i.p. bending
764*	(7)	a''	C—H o.p. bending
877	(8)	a'	C—CHO stretching
895	(9)	a''	C—H o.p. bending
954	(7)		,,
990	(5)		,,
1038	(9)	a'	C—C stretching (ring breathing)
1118	(9)	a'	C—H i.p. bending
1142	(10)		,,
1178	(10)		,,
1190	(10)		,,
1207	(10)		
1266	(10)	a'	C—OH stretching
1310	(10)	a'	C—H i.p. bending (CHO group)
1336	(10)	a'	O—H i.p. bending
1362	(10)		..
1432	(10)		..
1452	(10)	a'	C=C stretching
1575*	(4)		,,
1600	(10)		,,
1634	(10)		..
1649	(10)	a'	C=O stretching
1806	(5)		
1892	(5)		..
1931	(5)	A′	(1038+ 895)
1968	(5)		..
2049	(4)	A″	(1178+ 877)
2107	(4)	A″	(1207+ 895)
2171	(4)	A′	(1142+1038)
2218	(4)	A′	(1178+1036)
2363	(5)	A″	(1190+1118)
2795	(8)	a'	C—H stretching (CHO group)
2881	(9)		..
3080	(10)	a'	C—H stretching
3258	(10)	a'	O—H stretching (OH group)
3991	(5)	A′	(1649+1336)
4518	(5)	A′	(3258+1266)

i.p. = in-plane bending and o.p. = out-of-plane bending. Intensities have been given in parentheses.
* These frequencies have been taken from Raman data.

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Dept. of Spectroscopy,   O. N. SINGH.
Banaras Hindu Univ.,   M. P. SRIVASTAVA.
Varanasi-5,   I. S. SINGH
August 31, 1967.

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CORIOLIS COUPLING COEFFICIENTS: Al₂Cl₆, Al₂Me₆ AND Al₂Me₄Cl₂

THE electron[1] and X-ray diffraction[2] studies have indicated that the molecules Al_2Cl_6, Al_2Me_6 and $Al_2Me_4Cl_2$ have a bridged structure similar to diborane. They belong to D_{2h} symmetry with eighteen fundamental frequencies distributed among eight species as $4a_{1g} + 1a_u + 2b_{1g} + 3b_{1u} + 2b_{2g} + 2b_{2u} + 1b_{3g} + 3b_{3u}$. The normal modes of vibrations have been given by Bell and Longuet-Higgins.[3]

The normal coordinate treatment of these compounds has been made on the basis of modified Urey-Bradley force field by Shimanouchi *et al.*[4] The general valence force field, thermodynamic properties and the generalised mean square amplitudes have been calculated by Venkateswarlu *et al.*[5,6] The Coriolis coupling coefficients of these compounds have been investigated and reported in this paper.

The symmetry co-ordinates used are the same as those used by Venkateswarlu and Thirugnanasambandam.[7] The molecular parameters required for this investigation are taken from reference.[4] The non-vanishing Coriolis coupling constants, $\zeta^a (a = x, y, z)$ arise from $a_g \times b_{3g}$, $b_{1g} \times b_{2g}$, $a_u \times b_{3u}$ and $b_{1u} \times b_{2u}$, all belonging to the type R_x-only. These constants are evaluated by the matrix relation,

$$\zeta^a = L^{-1} C^a L^{-1}$$

where L is the normal co-ordinate transformation matrix and C^a-matrix is obtained by the vector method of Meal and Polo.[8] The values of the constants are listed in Table I.

TABLE I
Coriolis coupling coefficients (ζ^x_{ij}) of Al₂Cl₆, Al₂Me₆ and Al₂Me₄Cl₂

Couplings and ζ^x_{ij} elements		Values of ζ^x_{ij} elements		
		Al₂Cl₆	Al₂Me₄	Al₂Me₄Cl₂
(i)	$a_g \times b_{2g}$			
	$\zeta_{1,15}$	−0·2594	−0·3669	−0·5794
	$\zeta_{2,15}$	−0·1142	0·0659	−0·1246
	$\zeta_{3,15}$	0·9044	0·9101	0·7649
	$\zeta_{4,15}$	−0·3397	−0·1735	−0·3518
(ii)	$b_{1g} \times b_{2g}$			
	$\zeta_{6,11}$	−0·4803	0·4313	−0·1968
	$\zeta_{6,12}$	0·2995	0·0838	0·3171
	$\zeta_{7,11}$	0·8362	0·8310	0·9270
	$\zeta_{7,12}$	−0·1050	−0·4340	−0·2295
(iii)	$a_u \times b_{3u}$			
	$\zeta_{5,16}$	0·5967	0·8418	0·8794
	$\zeta_{5,17}$	0·4608	0·1972	0·2292
	$\zeta_{5,18}$	0·6098	0·5226	0·4326
(iv)	$b_{1u} \times b_{2u}$			
	$\zeta_{8,13}$	0·7044	0·4628	0·6063
	$\zeta_{8,14}$	−0·6770	−0·8341	−0·7440
	$\zeta_{9,13}$	−0·6319	−0·8177	−0·6561
	$\zeta_{9,14}$	−0·4692	−0·2671	0·2760

It is found that for the couplings $a_g \times b_{3g}$ and $a_u \times b_{3u}$, the following squared ζ-sum rule is satisfied.

$$\zeta^2_{1,15} + \zeta^2_{2,15} + \zeta^2_{3,15} + \zeta^2_{4,15} = 1$$

$$\zeta^2_{5,16} + \zeta^2_{5,17} + \zeta^2_{5,18} = 1$$

For the coupling, $b_{1g} \times b_{2g}$, the following relation is satisfied.

$$\zeta^2_{6,11} + \zeta^2_{6,12} + \zeta^2_{7,11} + \zeta^2_{7,12} = 1.$$

Regarding the coupling, $b_{1u} \times b_{2u}$, it is to be mentioned that since one of the vibrations in b_{2u} has not been considered, no such rule is considered fit.

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Department of Physics,   K. VENKATESWARLU.
Kerala University,   A. NATARAJAN.
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KINETICS OF THE OXIDATION OF ALCOHOLS AND α-HYDROXY ACIDS BY POTASSIUM PEROXYDISULPHATE— CATALYSED BY Ag+ IONS

THE kinetics and mechanism of the oxidation of a variety of organic and inorganic substrates by potassium peroxydisulphate has been the subject of investigation by several groups of workers both under uncatalysed conditions[1-6] and under conditions of catalysis by Ag+ ions and cupric ions.[7-13] The rate picture of the Ag+ catalysed oxidations of organic substrates has not been clearly settled yet. While in most of the investigations, the reaction velocity at any instant was proportional to the peroxydisulphate concentration and to the (constant) Ag+ concentration and was independent of the concentration of the organic compound, other studies report a dependence of one, one-half and zero (or half) on the peroxydisulphate, Ag+ and alcohol concentrations respectively.

Opinions are also divided on the silver ion species involved in the oxidations.

We present in this communication the results of the Ag+ catalysed peroxydisulphate oxidation of a few secondary alcohols, *viz.*, propanol-2, butanol-2, pentanol-2 and octanol-2 and three α-hydroxy acids, *viz.*, lactic acid, malic acid and mandelic acid and their ethyl esters. The oxidations were carried out in 50% acetic acid-water mixtures at constant ionic strength in presence of air. In the case of all the organic compounds studied, the order with respect to $S_2O_8^{--}$ was one and the rate of the reaction was also found to increase with increasing catalyst concentration in an unimolecular way.

In Table I are presented the data of the present investigations. We have compared the rates of oxidation of the organic substrates at a constant substrate concentration of 0·06 M. While it is generally reported that the Ag+ catalysed peroxydisulphate oxidation of alcohols is zero order with respect to the alcohol, and this is generally true for any one of the alcohols in the present study, we observe that the first order constant is certainly dependent on the nature of the alcohol. Structural variations in the alcohol moiety lead to definite changes in the absolute values of the rate constants.

TABLE I

Oxidation of secondary alcohols and α-hydroxy acids by peroxydisulphate—catalysed by Ag+

Solvent Composition :   Ionic strength $= 0\cdot2$ M
50% HOAc $-$ 50% H_2O $[Ag^+] = 1\cdot186\times10^{-3}$ M
$[ROH] = 0\cdot06$ M
$[S_2O_8^{--}] = 0\cdot028$ M

Alcohol	$k_1 \times 10^4$ sec.$^{-1}$		
	35° C.	40° C.	45° C.
Propanol-2	1·6298	2·4645	4·1740
Butanol-2	1·1135	1·7785	2·7455
Pentanol-2	0·9955	1·4080	2·2040
Octanol-2	0·8057	1·1480	1·8730
Lactic acid	3·6775	5·0630	7·0700
Mandelic acid	3·9830	5·3210	7·4050
Malic acid	1·1520	1·6880	2·5900
Ethyl lactate	0·5114	0·7750	1·0794
Ethyl mandelate	0·3215	0·4384	0·7405

The mechanisms proposed so far for these oxidations involve the rate-determining formation of a reactive silver species (Ag^{2+} or Ag^{3+}) and subsequent fast reactions (Schemes I and II).

I $S_2O_8^{--}$ . . $2SO_4{}^{\cdot-}$

$2SO_4{}^{\cdot-} + Ag^+ \xrightarrow{k_1} 2SO_4^{2-} + Ag^{3+}$
$Ag^{3+} + S \longrightarrow P$

I $Ag^+ + S_2O_8^{--} \longrightarrow AgS_2O_8^-$

   $AgS_2O_8^- \xrightarrow{k_1} Ag^{3+} + 2SO_4^{2-}$

or $AgS_2O_8^- \xrightarrow{k_1} Ag^{2+} + SO_4^{2-} + SO_4.$

   $Ag^{2+} + S \longrightarrow R + Ag^+$

   $R + S_2O_8^{--} \xrightarrow{k_R} P + SO_4^{--} + SO_4^{2-}$

   $R + SO_4.^- \longrightarrow P + SO_4^{2-}$

   $Ag^+ + SO_4.^- \longrightarrow Ag^{2+} + SO_4^{2-}$

(S = substrate; R = intermediate radical; P = product)

The radical mechanism can probably explain the variation of the rate constant when different reductants are used, for, here the $S_2O_8^{--}$ is also decomposed in a step that also involves the radical [R] leading to a rate expression

$$-\frac{d[S_2O_8^{--}]}{dt}$$
$$= k_1[Ag^+][S_2O_8^{--}] + k_R[R][S_2O_8^{--}]$$
$$= [S_2O_8^{--}]\{k_1[Ag^+] + k_R[R]\},$$

where [R] is the concentration of the free radical produced from the reductant. Although, by the steady state hypothesis the concentration of [R] is a constant, this may vary from reductant to reductant giving rise to a variation in the rate constant for the different systems, for the observed rate constant $k = k_1[Ag^+] + k_R[R]$.

The variation in rate with the α-hydroxy acids is also probably due to an additional cause in that intermediate silver species (Ag^{2+} or Ag^{3+}) may form co-ordinate complexes with the hydroxy acids and the stability or otherwise of these complexes may be one reason for the observed variations in rate. That this is likely, is shown by the values of the rate constants for the oxidation of ethyl lactate and ethyl mandelate—compounds wherein such stabilisation is very unlikely. It has been observed in earlier works that there was a constancy of the first order rate constants when positively charged reductants were used while there was a variation on changing to negatively charged ions or neutral molecules.[14]

We feel, therefore, that the slow step of the Ag^+ catalysed oxidations cannot be regarded as involving only the production of Ag^{2+} or Ag^{3+} but a direct participation of the secondary alcohols in the transition state seems to be called for.

Dept. of Chemistry,   N. Venkatasubramanian.
Vivekananda College,   A. Sabesan.
Madras-4, *September* 9, 1967,

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AMPEROMETRIC ESTIMATION OF GERMANIUM WITH 2′, 3′, 4′-TRIHYDROXY CHALCONE

The author reported that 2′, 3′, 4′-trihydroxy chalcone gave an yellow precipitate with germanium ions at pH 4·1 to 6·4.[1] Efforts to filter the complex and dry to constant weight were unsuccessful. Since the reagent gave a well-defined polarographic wave at pH 6·1 in an acetate buffer with $E_{\frac{1}{2}}$ at $-1\cdot155$ v (vs. SCE), an amperometric estimation of germanium was investigated.

An alcoholic solution of the reagent (0·025 M; containing 6·4 mg. of the reagent per ml.) was prepared. Germanium solution was prepared[2] from germanium dioxide (Spec. Pure) to give a solution containing 0·292 mg. of Ge/ml. Acetate buffer of pH 6·1 was prepared from 2·0 M acetic acid and 2·0 M sodium acetate and a 2·0 M solution of lithium chloride was used as supporting electrolyte.

Dr. Lange's Polarometer, Model-3, a direct reading instrument coupled with a multiflex galvanometer (Type MGF 2) was employed for current-voltage and Elico (L 1-10) pH mtere for pH measurements. An H-cell of the type designed by Lingane and Laitinen[3] was used both for polarographic and amperometric studies.

Polarogram for germanium was recorded in 0·1 M LiCl at pH 6·1 (acetate buffer) which gave a well-defined wave with $E_{\frac{1}{2}}$ at $-1\cdot550$ v (vs. SCE). No maximum suppressor was used.

Estimation of Germanium.—A known volume of the germanium solution (4·0 to 10·0 ml.), 15 ml. of alcohol (to prevent separation of reagent), 5 ml. of LiCl and 2·5 ml. of acetate buffer were made up to 50 ml. and transferred to the wider limb of the H-cell. Purified hydrogen gas was bubbled for fifteen minutes to expel dissolved oxygen. The dropping mercury electrode was then placed in the solution and drop time adjusted to 2·5–3·0 seconds. The applied voltage was maintained at $-1·35 v$ (*vs.* SCE). At this voltage, only the reagent gave diffusion current and germanium ions yielded a small current.

The reagent was then added from a micro burette (10 ml.). After each addition of the reagent hydrogen gas was bubbled to mix the solution. Current values were noted only after 1–2 minutes. Volume correction was applied for each current value and these values are plotted against the volume of the reagent added. The intersection of the two branches of the curve gave the equivalence point. As germanium ions yielded small currents at this applied voltage, the current values decreased till the end point was reached and increased rapidly thereafter. The results in a series of titrations are reported in Table I. From the results it could be deduced that the ratio of the reagent to germanium is 3 : 1, *i.e.*, 3 gram moles of the reagent is equivalent to one gram-atom of germanium and this ratio shows that only hydroxyls at 3′ and 4′ positions take part in the reaction with germanium and carbonyl group is not involved. 1·168 mg. to 3·0 mg. of germanium could be estimated with ±1·6% error.

TABLE I

Germanium (mg.)		Reagent consumed (mg.)	Ratio	Reagent (gm. moles)	Error (%)
Taken	Found			Germanium (gm. atoms)	
1·168	1·150	12·16		2·952	−1·57
1·461	1·452	15·36		2·983	−0·55
1·811	1·830	19·36		3·027	+1·04
2·336	2·311	24·32		2·968	−1·07
2·920	2·904	30·72		2·984	−0·55

Dept. of Chemistry,   K. SYAMASUNDAR.
S.V. University College,
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ANTIBIOTIC PRODUCTION BY STREPTOMYCES MARINUS

As early as 1946, Humm and Shepard described *Streptomyces marinus* isolate from marine sediments.[1] So far, no report exists regarding the antibiotic production of this organism.

During a survey of soil, sewage and manure for bacteria antagonistic to *Candida albicans*, a variety of micro-organisms were isolated.[2] One among the ten *Streptomyces* isolates was a strain of *Streptomyces marinus*. Our strain of *S. marinus* has the same morphological and cultural growth characteristics as that of *S. marinus* Humm and Shepard, but differs in the carbon utilization pattern (Table I).

TABLE I
Difference in carbon utilization

Carbon source		*S. marinus* Humm & Shepard	*S. marinus* isolate
Dextrose	..	+	−
Dulcitol	..	−	+
Inulin	..	−	+
Lactose	..	+	−
Raffinose	..	−	+
Sorbitol	..	+	−

+ → utilized ; — → not utilized.

When tested by cross-streak plate method, this isolate showed a marked anticandidal activity (zone of inhibition 32 mm. at cross-streak). Various liquid media were employed to select a suitable medium for the maximum antibiotic production. The media and the procedure adapted are the same as reported earlier.[3]

Nutrient broth (1% peptone, 0·5% sodium chloride, 0·5% meat extract, pH 7·2) supplemented with 1% mannitol has been selected as the suitable medium for large-scale antibiotic production. Antibiotic production by shake culture conditions reached the maximum on the third day when the pH of the original medium shifted from 7·2 to 9·0. Ether, benzene and chloroform could extract the antibiotic principle from the fermented broth filtrate. The crude antibiotic was yellowish brown,

material. The effect of the antibiotic
under various conditions reveal it to
at room temperature for 15 days, at
ion (4° C.) temperature for one month
ble above 50° C.

tibiotic spectrum is a narrow one, in
: that it is active against *Candida*
and *Staphylococcus aureus*. Towards
normal and pathogenic bacterial and
ltures tested (Table II), the antibiotic
ive.

TABLE II
Antibiotic spectrum

us aureus	+	Salmonella typhosa	—
α	—	Proteus vulgaris	—
s fæcalis	—	Shigella dysenteriæ	—
iZis	—	Candida albicans	+
mm smegmatis	—	Cryptococcus neoformans	—
coli	—	Coccidioidis immitis	—
neremoniæ	—	Aspergillus niger	—

active;   — → no activity.

logy Laboratory,   C. V. SUNDAR RAJ.
titute of Science,   M. SIRSI.
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OLITE FROM KONDAPALLI

detailed mineralogical study of the
; from the hill ranges of Kondapalli,
listrict, Andhra Pradesh, the writer
rved the common occurrence of
especially in the basic charnockites
nosites. Scapolite is never found as
rystals in these rocks but always as
grains in trace amounts replacing
; it occurs as small individual grains
sters within the plagioclase. The
of the plagioclase grains show no
tion and the extent to which the
is scapolitized differs from grain
ven in the same rock. The scapolite
early the same refractive index as the
plagioclase, but it is readily identi-
uniaxial character and greater bire-
Scapolite is considered to be a com-

mon accessory in the granulite facies rocks[1]
and the mineral is reported from many
charnockitic[2-4] and anorthositic[5,6] terrains of
Peninsular India; its occurrence in the rocks
of Kondapalli is here reported for the first time.

The scapolite occurring in the anorthositic
norite (55) from Kondapalli is studied in detail.
The plagioclase feldspar in this rock is
bytownite with composition $Or_{1.99}$ $Ab_{17.79}$
$An_{80.21}$ and scapolitization of the mineral is
rather common. Uncorrected electron micro-
probe measurements (with a possible maximum
error of 10%) indicated that the scapolite
contains 17% CaO, 30% Al_2O_3, 47% SiO_2 and
0·4% Cl, while the plagioclase has 16% CaO
(15·84% CaO by chemical analysis), 35%
Al_2O_3 and 47% SiO_2. These results indicate
that CaO and SiO_2 are nearly the same in both
the minerals, but Al_2O_3 is more in plagioclase
and less in scapolite and that the scapolite is
a mizzonite with more than 70% meionite. The
slightly higher CaO in scapolite when com-
pared to that of the enclosed plagioclase is not
without significance (*see* Marakushev,[7] 1964).
The occurrence of calcite and quartz in the
anorthositic norite under study may be of some
paragenetic importance.

The charnockites and anorthosites of Konda-
palli have been subjected to the granulite facies
metamorphism, but the Kondapalli scapolite is not
a primary product of this metamorphism unlike
the scapolite reported in some rocks of the Madras
State.[2,4] On the other hand the Kondapalli
scapolite is considered as an alteration product
of plagioclase. Knowledge of the plagioclase-
scapolite system in general is deficient and the
genesis of scapolites is still little understood.[1]
Shaw[8] has listed the main parageneses of sca-
polite; the principal requirement for scapolite
formation according to him is diminution of
p-H_2O and concomitant increase in one or all
of p-CO_2, p-Cl_2 and p-SO_3. The introduction
of such a fugitive constituent as Cl in not
inconsiderable amount (0·4%) during the for-
mation of mizzzonite from bytownite in the
Kondapalli anorthositic norite seems to be rather
significant. The presence of scapolite (and
calcite) in the Kondapalli rocks is taken as an
evidence of a certain volatile influx, but this
influx might have taken place subsequent to
the major granulite facies metamorphism. This
secondary mineralization may probably be
explained, as suggested by Quensel[9] for the
Varberg rocks of Sweden, "by a casual and
insignificant addition of volatiles during a

subsequent upheaval to higher positions within the crust of the earth".

This work was done in the Department of Mineralogy and Petrology, University of Cambridge, and the writer is grateful to Prof. W. A. Deer, F.R.S., and Dr. J. V. P. Long for their suggestions.

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AUTHIGENIC QUARTZ FROM THE LOWER KALADGI SANDSTONES, SALAPUR, BELGAUM DISTRICT MYSORE STATE

THE Lower Kaladgi (Pre-Cambrian) formations consisting of sandstones and shales are exposed around Salapur in the form of an anticline, where the beds strike W.N.W.-E.S.E., dipping 25° North and 10° South. A detailed study of the sandstones revealed the occurrence of quartz grains with authigenic growths. The sandstones are fairly hard and compact exhibiting pink and purple colours. They are mostly made up of medium-grained quartz and exhibit earthy lustre. Thin layers of chert, jasper and quartz pebbles occur along the bedding planes as intercalations.

Under the microscope, the quartz grains are sub-rounded to well-rounded (Fig. 1) indicating a long period of transportation. They also consist of randomly distributed sub-microscopic inclusions and in a few grains the presence of acicular inclusions of rutile has occasionally given rise to pseudo-cleavages. Under crossed nicols, the thin sections disclose that the detrital grains are cemented by siliceous matrix, thus converting the whole mass into a dense rock. The cementing material can be distinguished from the detrital quartz grains by being clear and pellucid.

This cementing material has given rise to authigenic growths around the detrital quartz

grains which invariably contain dusty opaque inclusions. Usually fringes of ferruginous impurities occur bordering the quartz grains as dust rings by means of which they can be easily distinguished from the secondary enlargements. The authigenic growths occur mostly in the form of overgrowths and rarely as outgrowths (Fig. 2). Majority of the overgrowths are in the form of rims and in irregular patterns (Fig. 3) around the cores. Some authigenic growths are scaly and appear as tabular envelopes (Fig. 4), while a few attain pyramidal outline (Fig. 5). Each overgrowth is in optical continuity with the detrital grain upon which it develops. It is observed that the authigenic growths are well-developed where there are intergranular spaces and partially developed where grains are concentrated. Usually the overgrowths are smaller than the nuclei, but a few are larger than the host grains (Fig. 6).

FIGS. 1–6. Camera lucida drawings. Fig. 1. Well-rounded detrital quartz with overgrowth, × 42. Fig. 2. Quartz grain showing outgrowth as well as overgrowth, × 75. Fig. 3. Detrital quartz with irregular secondary enlargement. × 75. Fig. 4. Tabular envelope around the parental quartz, × 75. Fig. 5. Overgrowths showing pyramidal outline, × 145. Fig. 6. Secondary enlargement completely enclosing the parental grain. × 150.

The maximum and minimum sizes of the parental grains range from $1 \cdot 12 \times 0 \cdot 71$ mm., to $0 \cdot 12 \times 0 \cdot 09$ mm., whereas overgrowths vary in size from $0 \cdot 49 \times 0 \cdot 43$ mm., to $0 \cdot 031 \times 0 \cdot 15$ mm.

A few thin sections of sandstone are planimetrically analysed by using Shand's integrating stage in order to know the relative proportion of the detrital grains and authigenic

overgrowths. The average of five analyses is as follows :

Quartz	..	67·68%
Quartz overgrowths	..	28·42%
Feldspars	..	1·75%
Heavy minerals	..	1·01%
Opaques	..	1·14%

Authigenic growth in quartz was first described by Sorby in 1880. Subsequently in 1884 similar enlargements were recorded by Irving and Van Hise[1] (cited in Pettijohn, 1957). They suggested that the quartz grains showing secondary growths occur in sandstones where cementing material will be of crystalline quartz. In the present study also, the authigenic quartz appears to have been developed at the expense of the cementing siliceous material.

According to Teodorovich[2] (1961) authigenic growths around quartz will develop during late diagenesis due to recrystallization. Thus it can be observed that the secondary growths of quartz in the Kaladgi sandstones have also been developed after deposition of the sediments and probably during diagenetic reorganization, while cementation was in progress. Further as the sandstone beds contain beautiful ripple marks, a typical feature of shallow water deposition, a deltaic environment for the process cannot be ruled out.

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B. V. GOVINDA RAJULU

M. J. CHANDRASEKHARA GOWDA.

Dept. of Geology,
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TAXONOMIC SIGNIFICANCE OF SOME MORPHOLOGIC CHARACTERS OF THE MEMBERS OF THE FAMILY NODOSARIIDAE (FORAMINIFERS), FROM THE VALANGINIAN DEPOSITS OF CRIMEA, U.S.S.R.

FROM the statistical analysis of about 3,500 specimens of the Nodosariids, the value of some morphologic elements, characteristic of different taxonomic categories—from family to species is estimated.

An important feature of the Order Nodosariida is a combination of such characters like the wall with radiating calcite crystals and radiating aperture, while the shell pattern is a secondary character. The latter, to a great extent, is a primary character of both Family as well as Subfamily, while chief characters of the Subfamilies in the limits of the Family are a combiniaton of the different shell patterns. In the systematics followed by us, in the Fam. Nodosariidæ are grouped shells which are single chambered, uniserial and planispiral.[1]

The generic characteristic features in the limits of Family Nodosariidæ, are the following : character of shells in the initial stages; character of symmetry and of transverse section ; form of chambers ; character of jointing of adjacent chambers and in some cases character of aperture. Many investigators[2-12] tried to establish the taxonomic significance of the aperture. While examining this character in the representatives of some genera of the Family Nodosariidæ from the Valanginian deposits of Crimea, it was observed that in the majority of genera, excluding the genus Lingulina, the aperture happens to be a character of high taxonomic rank, *viz.*, a feature characteristic of the whole Family Nodosariidæ. Only in the representatives of the genus Lingulina, character of aperture could be considered as a characteristic feature of the generic level.

The characteristic features in the limits of a majority of species of this Family are the following : outline of the shells ; character of sides, peripheral border, dorsal and ventral portions ; character of the chambers ; character of overlapment of chambers from the peripheral border ; character of septal sutures, ornamentation of the shells and ratio of sizes of the shells.

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S.V. University College,
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OCCURRENCE OF ALGAL PHOSPHORITE IN THE PRE-CAMBRIAN ROCKS OF RAJASTHAN

THE present note records the occurrence of phosphorite deposits in the pre-Cambrian rocks of India. These deposits are associated with the stromatolites in the Aravalli rocks[1] exposed in the vicinity of Udaipur (24° 35′ : 73° 42′), Rajasthan.

naceous phyllites, schists and the calcareous rocks both along and across the strike is ubiquitous in the area.

The phosphatic material is associated only with bluish-grey stromatolites which are mainly seen in dolomitic marble and to a lesser extent in the cherty brecciated quartzite and schist. The typical phosphatic stromatolite, in the dolomitic marble, is represented by ill-defined cylindrical columns with convex laminæ. The columns vary in height from 2 to 15 cm. and are 1 to 1·5 cm. wide at the base and upto 2·5 cm. at the top in some places. In plan these are oval, circular to elongated in shape. Locally 'fan-shaped' columns are seen. The phosphatic 'algal' structures associated with cherty brecciated quartzite do not show any well-developed pattern but are randomly oriented. In the same area especially near Kanpur (24° 34′ : 73° 46′) non-phosphatic stromatolites in the form of 'collenia' and 'weedia' are also seen in the dolomitic marble. Some of the phosphatic stromatolite horizons are fairly extensive and are likely to be of economic importance.

Durgadas Path,   MUKTINATH.
Jaipur, *August* 1, 1967.   V. N. SANT.

FIGS. 1–2. Phosphatic stromalites in Aravalli marble.

The Aravalli rocks of Udaipur area[2] rest on the Banded Gneissic Complex and comprise basal conglomerate, quartzite and green schist, followed by mica schist, carbonaceous phyllite, pure and arenaceous marble and minor cherty brecciated quartzite, with an overlying rapidly alternating sequence of greywackes and phyllites.[3] Rapid transition between carbo-

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A DAMSEL-FLY AS THE SECOND INTERMEDIATE HOST OF A PLEUROGENETINE TREMATODE

Enallagma parvum Selys. [Odonata : Zygoptera : Cœnagrionidæ, (Cœnagriidæ)—narrow-winged damsel-flies], collected from Raya (7-8 miles away from Mathura), yielded an interesting metacercaria with a distinct pleurogenetine affinity. Of the 37 specimens examined, 8 were found to be infected. This form, also encountered in three libelluloid dragon flies, *viz.*, *Crocothemis servilia servilia* (Drury), *Brachy-*

themis contaminata (Fabr.), and *Orthetrum sabina* (Drury), is briefly described here.

The fairly large-sized but nearly spherical cysts (Figs. 1 and 2) measured (average of 4 cysts) $0 \cdot 658 - 0 \cdot 862 \times 0 \cdot 588 - 0 \cdot 833$ mm. in size. The transparent cyst-wall, single-layered, without laminations and with a brownish hue, measured $0 \cdot 011 - 0 \cdot 014$ mm. in thickness. The contained juvenile nearly filled up the space inside. A cover-slip preparation (Fig. 2) revealed clearly the internal anatomy with a spinose body wall, the two suckers—the oral

FIGS. 1-5. Fig. 1. Photomicrograph of metacercaria, × 75. Figs. 2-5. Camera lucida drawings— Fig. 2, a cyst; Figs. 3 and 4, excysted juvenile; Fig. 3, living; Fig. 4, stained mount; Fig. 5, eggs.

sucker larger than the acetabulum, the muscular pharynx, two intestinal cæca extending to near the acetabulum, two large spherical testes lying lateral to acetabulum, the pretesticular ovary, and a prominent but slightly curved cirrus-sac with well-developed seminal vesicle and ejaculatory duct and opening laterally in the region of the oral sucker.

A light pressure from a needle over the coverslip liberated the juvenile in which the morphological details were studied.

The excysted juvenile (Fig. 3) measured (average of 3 specimens) 0·804–1·432 mm. in length and 0·531–0·775 mm. in maximum width. The cuticle carried throughout minute spines. The subterminal oral sucker, of 0·161–0·175 mm. × 0·161–0·190 mm. in size, was followed by the muscular pharynx of 0·044–0·058 mm. in length which, through a small oesophagus, opened into the intestinal caeca passing outwards and backwards to near the middle of the acetabulum. The acetabulum, of 0·146–0·171 mm. × 0·146–0·175 mm. in size, lay at 0·496–0·599 mm. distance behind the anterior extremity. The excretory pore was subterminal and, through a very short median stem, opened into the two wide cornua which gave a V-shaped appearance to the excretory bladder—the limbs extending anteriorly to a little distance behind the acetabulum. The two well-developed rounded and systematically-placed testes—left testis of 0·117–0·262 × 0·132–0·263 mm. and right of 0·146–0·219 mm. × 0·132–0·209 mm. in size, were situated laterally to the acetabulum. The club-shaped and elongated cirrus-sac, somewhat curved distally, extended from the acetabulum to the side of the oral sucker lying opposite to the ovary and, after crossing the intestinal cæcum, opened terminally at the genital pore situated in the anterior region of the oral sucker, either marginally or slightly ventrally. The nearly spherical and intercæcally placed ovary, of 0·073–0·117 × 0·059–0·102 mm. in size, lay opposite to the cirrus-sac but immediately in front of the acetabulum with the Mehlia's gland mass situated between it and the acetabulum. The coils of the uterus were visible postero-laterally to the acetabulum and towards the genital pore—some of the coils containing eggs were also detected in the cysts examined directly. In the preacetabular zone, the vitelline follicles were mostly extracæcal and lateral to the oral sucker and the pharynx with a few follicles passing inwards towards the cæca.

The fixed stained mounts (Fig. 4) gave the following measurements (average of 3 specimens); length 0·628–1·067 mm.; breadth 0·395–0·628 mm.; oral sucker 0·132–0·161 mm. in diameter; pharynx 0·036–0·051 mm. in length; œsophagus 0·022–0·037 mm. long; acetabulum of 0·116–0·153 mm. in diameter; left testis of 0·117–0·190 mm. × 0·102–0·175 mm. and right of 0·117–0·190 mm. × 0·117–0·175 mm. in size; ovary of 0·044–0·102 mm. in diameter; uterus in some specimens with nearly a dozen eggs of 0·020–0·022 mm. × 0·016 mm. in size (Fig. 5).

The juvenile stage exhibited features characteristic of the pleurogenetine genus *Pleurogenes* Looss, 1896 (Syn. *Pleurogenoides* Travassos, 1921) which, according to Yamaguti (1958), is well represented in our anurans and a fish with such species as : *P. prayagi* Mehra *et* Singh, 1926, in *Rana tigrina* ; *P. gastroporus* (Lühe, 1901) var. *equalis* Mehra et Negi, 1928, in *R. cyanophlyctis* ; *P. sitapurii* (Srivastava, 1934), in *R. cyanophlyctis* ; *P. orientalis* (Srivastava, 1934), in *R. cyanophlyctis* ; *P. bufonis* Kaw, 1943, in *Bufo viridis* ; *P. sawanensis* Gupta, 1954, in *Rana cyanophlyctis* and *P. pabdai* (Pande, 1937), in *Callichrous pabda* (fish host).

Okabe and Shibue (1951) have reported, during life-cycle studies, that the freshwater shrimp, *Neocaridinia denticulata*, harboured the metacercariæ of *P. japonicus* occurring in *R. nigromaculata nigromaculata*. In Ceylon, Dissanaike (1960) found that over 90% of the freshwater crab, *Parathelphusa ceylonensis* (collected from paddy fields), were infected with a metacercaria suggestive of lecithodendriid affinity. This form, when fed to *R. haxadactyla*, had developed in 3 days into the adult identified as belonging to *P. sitapurii*. The fluke was also found in the frog taken from the paddy fields. Like our material, the metacercariæ, in these studies, had exhibited eggs inside the developing uterus.

Subsequent studies, with laboratory raised definitive hosts, could alone determine the true specific identity of this larval form. The present findings, unlike the observations of Okabe and Shibue and Dissanaike who had found crustaceans as the second intermediate hosts of certain species of *Pleurogenes*, records, for the first time, a *Zygopteran* odonata to harbour this metacercaria.

Zoological Survey of India, Calcutta, for the specific identification of the insect host.

Dept. of Parasitology,   K. MURALEEDHARAN.
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NOTES ON ANIMAL RELATIONSHIPS : A FLYING FISH PARASITISED BY AN ISOPOD, AND A COPEPOD ASSOCIATED WITH AN INQUILINE CIRRIPEDE

A FLYING fish obtained from the Madras coast in September 1962, was found to be infested at the vent region by a lernæid copepod on which a pedunculate cirripede was attached. The same fish was also parasitised by a cymothoan isopod at the opercular region. Although there are records of flying fishes being affected by bipartite infestation of pennellid copepods bearing striped goose barnacles (Wilson,[3] Daniel and Premkumar[1]) there appears to be no report of a tripartite infestation, *i.e.*, parasitic isopod and copepod infesting a single host-fish, the copepod in association with a lepadid barnacle. Therefore, it is considered worthwhile to photograph and record this infestation Fig. 1.

FIG. 1

The fish-host was identified as *Parexocoetus mento* (Val.) which occurs commonly in the Bay of Bengal. The parasitic lernæid copepod identified as *Pennella* sp. was directly embedded into the body of the fish at the vent region and the posterior portion hanging freely was infested with a pedunculate cirripede *Conchoderma virgatum* (Spengler). The ectoparasitic isopod *Nerocila* sp. was attached to the host by hook-like projections of the mandibles, first maxillæ and first two thoracic legs.

The isopod and copepod draw their nourishment from the blood of the host-fish and are true parasites. The barnacle, however, uses the copepod only as a means of anchorage and support, obtaining its food by its thoracic cirri from the water and neither gives anything nor takes anything from the copepod or the fish and, is therefore merely an inquiline.

The present record confirms the association of the cirripede *Conchoderma virgatum* (Spengler) with flying fishes through intermediate pennellid copepods. This cirripede also occurs generally on floating logs, sea snakes, turtles, carapace of crabs and rarely on fishes such as *Mola rotunda* Cuvier, *Mola mola* (L.), *Gymnothorax favagineus* (Schneider), *Caranx hippos* L., *Echeneis naucrates* L. and *Isurus oxyrhinchus* Rafinesque (*vide* Stubbings[2]), and is world-wide in distribution. The distribution of the isopod and copepod parasites, however, is probably co-extensive with that of the flying fish *Parexocoetus mento* (Val.).

We are thankful to the Director, Zoological Survey of India, for affording facilities.

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POLLEN GERMINATION IN OIL PALM —*ELAEIS GUINEENSIS* JACK.

THE oil palm is an important economic plant belonging to the family Palmæ. It is indigenous to West Africa but now very widely cultivated in many tropical countries of Asia and Africa. The plants flower throughout the year and the oil is extracted from the pericarp. Other details are summarized in the well-known reference works.[1,2] Artificial pollination is carried out extensively to obtain good fruit-set and the procedures of this process are already outlined.[3,4] When compared with other angiosperms the pollen germination in palms is poorly understood.[5,6] Therefore, the germination of oil palm pollen was studied and some important points of the results are briefly summarized.

Morphologically, the pollen grains of *E. guine-ensis* are triangular in polar view, oblate in shape, trichotomosulcate, with a smooth exine. On an average they measure $22\,\mu \times 33\,\mu$. Fresh pollen were collected from the palms growing in Chemara Research Station, Johore, South Malaysia. They were germinated in double distilled water as well as sucrose and borax (sodium tetraborate) solutions by the hanging drop method,[7] at room temperature, in the laboratory. About one hundred pollen grains were observed in each case at the end of twenty-four hour period and the percentage germination was calculated. Sucrose solutions of 5–50% as well as borax solutions of, 10, 100

and 1000 mg./litre were used to test the effect of these substances on the germination as well as the tube length. The results are summarized in Table I.

Better germination resulted in the sucrose solutions of 10–30% when compared with the control. In 35% and higher concentrations, the grains did not germinate and only protrusions were observed. The optimum germination was in 20% sucrose solution, the pollen tubes attaining an average length of $480\,\mu$. Boron in the form of borax solution markedly improved the percentage germination as well as tube length. The best result was secured in 10 mg./litre solution where 89% germination and an average

FIGS. 1–5. *Elæis guineensis*, pollen germination. Fig. 1. In water, × 300. Fig. 2. In 5% sucrose, × 1,555. Figs. 3–4. In 10% sucrose, × 1,890 ; × 2,214. Fig. 5. In 20% sucrose, × 1,890.

tube length of 1570 μ were obtained. At 1 mg./2 concentration boron was less effective.

TABLE I

Percentage germination and pollen tube length in different media after 24 hours at room temperature

Medium	Concentration %	Germination %	Average tube length in μ
Distilled water (control)	..	58	230
Sucrose	5	58	152
	10	62	165
	15	64	198
	20	78	480
	25	64	390
	30	59	247
	35	protrusions only	
	40	..	..
	50	..	..
Borax	10 (mg./l.)	89	1570
	100	76	410
	1000	74	410

The pollen grains are mostly monosiphonous. In distilled water and the lower concentrations of sucrose (5–15%), pollen tubes were short, stout, often swelling and rupturing at the tips (Fig. 1). Again in the lower sucrose media, the tubes were shorter and the prominent forking of the tubes either at the tip or near the pollen grain at the point of emergence was observed (Figs. 2–5). Pollen tubes assumed a zigzag outline in the optimal sucrose concentration. In 25% and 30% sucrose solutions nearly 12–15% of the pollen tubes burst at their tips, ejecting their protoplasmic contents.

Pollen tubes in the borax solutions were long, often zigzagged and with marked swellings at their tips. In the optimal borax concentration, the inner wall surface of most of the pollen tubes were lined with callose plugs of various sizes and shapes.

It may be concluded that both sucrose and borax solutions were favourable for pollen germination in *E. guineensis*. Generally, most of the pollen grains so far studied germinate successfully in sugar solutions. The nutritive and osmotic influences of various sugars on the growing tubes are well summarized.[6] Likewise the previous studies show, that boron improves the percentage germination as well as the pollen tube length, and its threefold influence on these two processes are recently reviewed.[6] Branching of pollen tube is not very common, and is recorded only in certain cases.[7] Under the influence of 2, 4-D, colchicine

and pollen extract, branching was common.[8,9] In the present investigation in 10–12% of the grains, the branching of the tubes was common in lower sugar media and without the influence of any other substance. The pollen grains remained viable upto 3 days after anthesis at room temperature, and only about 20% germination resulted after this period. Comparatively, the duration of pollen viability in oil palm is longer than that in areca-nut palm.[5]

We are grateful to Mr. R. Bull, Director, Chemara Research Station, for the supply of fresh pollen used in this study.

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ON *OEDOCLADIUM PRESCOTTII* ISLAM FROM GUJARAT

OUT of 12 species of *Oedocladium*, four species, *O. terrestre* Biswas, *O. operculatum* Tiffany, *O. himalayense* Randhawa and *O. indicum* Kamat, have been recorded so far from India.[1-4] *O. prescottii* Islam[5] collected from Gujarat and described here is an addition to Indian *Oedocladium* species.

O. prescottii Islam is under the observations since 1962 when it was first collected from Botanical Garden of V. P. Mahavidyalaya, Vallabh Vidyanagar. It was found growing on damp sandy alluvial soil under one of the Mango trees. It was a felt-like greenish mass with *Microcoleus* and protonema of Moss. The plants appear soon after the first rain in the 3rd week of June.

Plants monœcious, freely branched, branches alternate ; colourless rhizoids of two types—(*i*) long narrow mostly unbranched developed from the oospores and (*ii*) occasionally branched rhizoids from the lower cells of the main branches. Oogonia solitary, terminally placed usually on one-celled sexual reproductive branches, sometimes 2–5 such branches from

the same cell; oogonium ellipsoid to ovoid with supreme operculum; oospore filling the oogonium, orange-red with smooth wall layers; antheridia hypogynous, 2-4 in series, sub-cylindrical with single antherozoid in each antheridium.

FIGS. 1-5 *Oedocladium prescottii* Islam. Fig. 1. Mature plant—showing the cell structure and developing sex organs, × 207. Figs. 2-4 Showing different stages of antheridia and oogonia, × 207. Fig. 5. Part of a branch to show the nature of mature oospore, × 207.

Cells of the rhizoids from the aerial parts of the plant $6 \cdot 0 - 9 \cdot 0\,\mu$ diameter and 8-10 times as long; branches of similar strength in diameter as in the main axis; cells cylindrical; cell division terminal with apical conically pointed cells, occasionally intercalary; vegetative cells $10 \cdot 5 - 13 \cdot 0\,\mu$ diameter and 5-6 times long; pyrenoids 1-2 rarely 3 in a row per cell; oogonia $30 \cdot 0 - 42 \cdot 0\,\mu$ long and $21 - 0 - 29 \cdot 0\,\mu$ diameter; oospore $25 \cdot 0 - 33 \cdot 0\,\mu$ in length and $(17)^{\cdot} - 20^{\cdot} 0 - 0 \cdot 25\,\mu$ in breadth; antheridia $9 \cdot 0 - 11 \cdot 0\,\mu$ broad and $13 \cdot 0 - 19 \cdot 0\,\mu$ long.

In the next week, within 2 or 3 days after the first rain, the oospores germinate and first rhiziod comes out by burstisg the oospore on one side and fixes the plant. The main axis also develops on the side of the rhizoid and becomes aerial in the opposite direction. The cells of the subterranean axis are colourless. As it reaches the surface of the soil, it becomes

profusely branched. The branches develop as small conical outgrowths just above the septa of the cells on the main axis. They become elongated and separated by the transverse walls laid down near the main axis.

The present plant agrees in general with the description of *O. prescottii* Islam.[5] The sexual reproductive branches are usually one-celled but rarely two-celled.[5] Akinetes reported by Islam and Sarma[6] have not been observed in this plant, but vegetative bud-like structures were seen near the bases of the main axis. Such buds have been described in *O. operculatum* Randhawa.[2]

Oedocladium species is considered to be a rare species. Only few reports of the species from the different parts of the country are available at present. *O. terrestre* Biswas[1] from Calcutta, Bengal; *O. operculatum* Tiffany and *O. himalayanse* Randhawa[7] from Beneras, M.P.; *O. indicum* Kamat[4] from Ahmedabad, Gujarat and one species from Kolhapur[8] are only the records so far from the different States of the country.

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Sardar Patel University,
Vallabh Vidyanagar,
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A CASE OF SEX-LINKED INHERITANCE IN MAN

A CHILD was observed to possess a peculiar feature—a small dimple-like circular depression in the lowermost part of the back of the trunk, just above the anus. This is referred to as the simplest form of *Pilonidal sinus* in the literature (Rose and Carless, 1960). Enquiries made in the family to which the above child belonged indicated this to be a hereditary character, being expressed in some other members also. The information elicited and the conclusions drawn are presented herein.

The child under study is a male (III-5) having only one sister (III-4). The parents (II-3 and 4) as well as the sister of the child do not possess this character. But, the mother's father (I-2, grandfather of the affected) shows the presence of this feature, though her six brothers and four sisters (II-1, 3 and 5 to 13) do not have this. Of them, only one sister (II-1) is married and none of the brothers. The married sister has three children, two sons (III-2 and 3) and one daughter (III-1). It is interesting to find that, of the two sons, one does possess the characteristic under consideration while the other (III-3) is normal (does not have the depression). The female child (III-1, sister) as in all other cases does not express the character. It is to be pointed out that the father (II-2) of these three children is normal like the mother.

Riley (1948), Shull (1948), Hill and Hill (1955) and Sinnott, Dunn and Dobzhansky (1958) have described the inheritance pattern of various traits in human beings. Among these, some like partial and complete colour blindness and hemophilia have been found to be sex-linked. Dronamraju (1961) has reported the inheritance of *Hypertrichosis pinnæ auris* to be governed by a single gene being located on Y-chromosome of man. Since a sex-linked gene is inherited in a criss-cross manner, the males will show the effects of that gene in the non-homologous part (X- and Y-chromosomes in man consist of homologous and non-homologous parts), whether it is in dominant or recessive state. In the absence of dominant X-linked allelic genes, the effects of X-linked recessive genes are never obscured in the male. In the females, however, the effects of a recessive gene may be submerged by the action of its dominant allele. In the present case, the second generation is skipped off while the affected ones are seen in the first and the third generations. This feature could not have been autosomal as in that case the possibility of its appearance in the third generation is as remote as in the second. On the other hand, the pattern of inheritance is compatible with the hypothesis that the character is X-linked and the gene controlling it is recessive. The observation of Ian Aird (1958) and Rains and Capper (1965) that males with this condition outnumber females by four to one, lends support to this view.

It is apparent that the character is transmitted from the father (I-2) to his grandsons (III-2 and 5), through the daughters (II-1 and 3) who

by themselves do not exhibit this character (normal). The absence of the trait in the second grandson (III-3) through the first daughter (II-1) strengthens the assumption that the mother (II-1) is heterozygous. The character under study appears to be the simplest form of *Pilonidal sinus* possibly conditioned by a recessive gene on the X-chromosome. The pedigree is shown in Fig. 1.

FIG. 1. Pedigree showing the inheritance of the trait under study as a sex-linked recessive through three generations. Squares represent males and circles females. Solid blocks possess the trait under study. Crossed blocks indicate heterozygosity (phenotypically normal).

Faculty of Genetics and   M. MAHADEVAPPA.
  Plant Breeding,   C. NAGARAJAN.
Agricultural College and   B. W. X. PONNAIYA.
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A NEW DISEASE OF POTATO TUBERS CAUSED BY *GILMANIELLA HUMICOLA* BARRON

IN March 1966, when late blight differentials grown from January to March, 1966, were harvested, minute brownish necrotic spots around lenticels and eyes (Fig. 1) were observed on some tubers of three differentials (S4, S6 and S8). During storage at room temperature (15° C to 25° C.) from March to June, 1966,

the infected tubers developed prominent necrotic lesions ranging from 2–4 mm. near the lenticels to 3–6 mm. at the eyes. Sometimes 2–5 lesions around lenticels, enlarged to coalesce with each other and covered larger areas. Infection did not develop deep in the tuber tissues and tubers remained firm during storage. The important observation was that almost all the eyes of affected tubers were killed rendering tubers unfit for seed purposes.

FI . 1. Tubers infected with *G. humicola.*

An examination of necrotic lesions both on the lenticels and the eyes revealed that infected tissues contained hyaline to brown septate fungal hyphæ (2 to 5 μ broad) and smooth rounded dark brown spores (8 to 10 μ in diameter). Surface-sterilized infected tuber portions yielded a spore bearing fungus, belonging to Fungi Imperfecti, on potato dextrose agar. The fungus was identified as *Gilmaniella humicola* Barron by Dr. M. B. Ellis of Commonwealth Mycological Institute, Kew, England.

The culture grows rapidly on potato dextrose agar. The culture is greyish in the beginning and gradually becomes greyish-brown on account of conidia being formed throughout the mycelium. The mycelium consists of septate, branched hyphæ, 2 to 5 μ broad, with highly refractive septa. The hyphæ are often swollen near the septum and provide node-like appearance. The conidia, 8–10 μ in diameter, are dark brown, smooth and rounded having well-marked single apical germpores. They are terminal, borne singly or in groups on short, simple or branched conidiopores. Stalk cells are frequently inflated.

The genus *Gilmaniella* was established by Barron, in 1964 with *Gilmaniella humicola* as

type species. The organism has been isolated from soils in Egypt, England and Canada, from pony dung in India, from *Clematis* sp. in England and beet seedlings in Ireland. The isolate from potato resembled one described by Barron.[1]

Pathogenecity tests were carried out by inoculating sterilized soil in pots with pure cultures of *G. humicola* and burying tubers of late blight differential (S8) for three weeks. The soil was kept moist and incubated at 22° C. ($\pm$ 2° C.). On subsequent storage for 3–4 weeks, tubers developed necrotic lesions at lenticels and eyes.

Preliminary studies on host-parasite relationship indicated that tuber infection takes place through natural openings—eyes and lenticels. Infection also developed through injured tuber surface but no penetration through intact tuber surface was observed. Mycelium is both intercellular and intra-cellular. Some of the affected host cells become brown, thick-walled and crushed and are probably responible for brown necrotic appearance of lesions on tuber surface. The fungus is easily isolated on potato dextrose agar by placing sterilized diseased tuber portions at 22° C ($\pm$ 2° C.). The fungus grows well at this temperature.

This is the first ever report of *Gilmaniella humicola* Barron, attacking potato tubers. The disease may become serious on account of rendering seed tubers blind during storage.

Plant Pathology Section,   DEVENDRA SAHAI.
Central Potato Research
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THE MODE OF INOCULATION AND GROWTH OF EXCISED ROOTS OF *PHASEOLUS AUREUS* ROXB. IN STAB CULTURES

EXCISED roots of *Phaseolus aureus* Roxb. could be grown on the surface of slants or as stabs within the agarified synthetic medium.[1] A comparison of the rate of growth of the excised

roots of *P. aureus*, *Trigonella fœnum-grœcum* Linn., *Pisum sativum* Linn., and *Cicer arietinum* Linn. revealed that *P. aureus* was peculiar in that its growth on slants was far superior to that on stabs.[2] In stabs the cut ends of the roots were inoculated flush with the surface of the medium. Yet, in some instances, these had a tendency to rise a few millimetres above the medium a day or two after inoculation. Since such roots grew better than the others, it was thought desirable to elucidate whether the growth of roots inoculated flush with the surface of the medium (Procedure 1) was inferior to those whose ends projected a few millimeters above the medium (Procedure 2).

and 2 respectively. While only three of the roots are in focus in photo 1, all the four could be seen in Photo 2. It would be apparent from a comparison of the lengths of the roots removed from the tubes (A and B, Photo 3) that procedure 2 is superior to procedure 1.

Photo 4 is of a tube in which the four roots were handled initially according to procedure 1. On the fourth day, roots 2 and 4 were taken out of the medium and re-inoculated into the same tube with their cut ends exposed. Six days later, they were taken out and photographed (Photo 5). As would be obvious, the growth of roots 2 and 4 is superior to that of 1 and 3.

FIGS 1-13.

Photos 1 and 2 illustrate the 6-day growth of roots inoculated according to procedures 1

In another tube, two of the roots (2 and 4) were handled according to procedure 1 and the

others (1 and 3) according to procedure 2. The data are presented in Table 1.

TABLE I

Root Nos.	1	2	3	4
Procedure adopted	2	1	2	1
Length of initial inoculum	4·5 mm.	5·0 mm.	4·5 mm.	4·5 mm.
Length on 3rd day	38·5 mm.	11·5 mm.	28·5 mm.	10·5 mm.
Length on 5th day	54·0 mm.	46·0 mm.	36·0 mm.	10·5 mm.

Between the 3rd and 4th day the growth of root 2 was impeded by the curvature of one of the roots. As a consequence, its cut end was pushed above the surface of the medium (arrow, Photo 6). Between the 4th and 5th day, therefore, it exhibited a remarkable growth. The roots were removed from the tube on the 10th day and photographed (Photo 7). Root 4 alone was stunted in growth. Photos 8 and 9 would illustrate the radical differences in the rate of growth of roots handled according to procedures 1 and 2 respectively and grown for 19 days.

The behaviour of the root tip placed on the surface of the medium was also elucidated. The growing tip of such roots (tube B in Photo 10) penetrated into the medium a day or two after inoculation and behaved like stab cultures (tube A, Photo 10) handled according to procedure 2. On the sixth day there was no marked difference in the growth of roots whether they were placed on the surface of the medium or inoculated into it with their cut ends exposed (compare A and B, Photo 10). However, the growth was inferior when compared to that on a slant (compare C with A and B in Photos 10 and 11).

The question whether the roots growing on stabs would equal in growth those on slants was elucidated by a comparison of their relative lengths on the 19th day (Photo 12). As would be seen, those cultured on slants (A) were superior to those on stabs (B and C). Among stab cultures themselves, those handled according to procedure 2 (B) were superior to those merely placed on the surface of the medium (C).

The rates of growth of roots in slant cultures slows down as their tips reach the base of the tube. To elucidate whether the limiting factor for growth is the height of the tubes, roots were inoculated on slants in bacteriological (150 × 19 mm.) and boiling (200 × 25 mm.) tubes. Photo 13 illustrates the growth of these cultures on the 19th day. The roots grown in boiling tubes were longer.

The roots grown on agar slants were generally thinner and had more laterals than those cultured as stabs. But when the growth of the tip is impeded by the agar at the bottom of the slant, it becomes stumpy and then penetrates the agar. Curiously enough, in cultures at this stage there is a gradual thickening of the other regions commencing from the tip. The histological changes that accompany this thickening is under investigation.

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Cytogenetics Labo.,   S. Royan-Subramaniam.
Dept. of Biochem.,   S. Subramanyam.
Indian Institute of   G. Meenakshi.
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REVIEWS AND NOTICES OF BOOKS

... S. Weerberger; Sulfonamide-Resistant
............, by Harry A. Feldman. C. V. R.

British Medical Bulletin : Aspects of Medical
Virology (Vol. 23), Number 2, May 1967.
British Medical Bulletin, 65, Davies Street,
London, W. 1), 1967. Pp. i + 105 to 204.
Price £ 1.10 sh.

The advances described in this issue of British
Medical Bulletin arise from the wide-ranging
explorations of virologists, microbiologists,
........., biochemists, molecular biologists,
........., pharmacologists and veterinary
.... workers in the field of medical virology.

The titles of the 16 contributions from 24 dis-
.... British workers are as follows:
Introduction; Interferons and Viral Multiplica-
tion; Chemotherapy of Viral Infections; Small-
... and vaccinia; Common Colds and Related
......, Morphological and Antigenic Sub-
...... of Viruses; Scrapie and Its Wider
Implications; Virulence in Newcastle Disease
......, Viral Oncogenesis; Reoviruses; Genetic
...... of Animal Viruses; Doublet Patterns
... Evolution of Viruses; Non-Structural
Proteins of Viruses of Vertebrates; Viral
Multiplication In Vitro In Relation to Patho-
........, Defective and Delayed Myxovirus
Infections, Rubella; Replication of Small RNA
....   C. V. R.

Enzyme Cytology. Edited by D. B. Roodyn.
(Academic Press, Inc. (London) Ltd., Berkeley
Square House, Berkeley Square, London W. 1),
1967. Pp. xx + 587. Price 140 sh. $ 25.00:

Enzyme cytology is a relatively new scientific
.... concerned with the elucidation of the
...... properties of sub-cellular components.
.... new hybrid, a remarkable synthesis of the
two great disciplines of Enzymology and Cyto-
...... has contributed a series of findings of the
...... significance to biology. This book brings
..... findings together, covering the whole field
of enzyme cytology. After an introductory
chapter on general principles, there follow
chapters on nuclei, mitochondria, peroxisomes,
chloroplasts, lysosomes, membranes, ribosomes and
.... The general design of the chapters is
more or less the same, with each subject being

surveyed in a comprehensive fashion, without excessive emphasis on the authors' own special fields of research. The text is brought together by an extensive subject index, and for easy reference the enzymes discussed are listed according to their Enzyme Commission numbers. Some suggestions for terminology in enzyme cytology have been included as an appendix.

The titles of the chapters and their respective authors are : 1. General Principles, by C. De Duve ; 2. The Nucleus, by G. P. Georgiev ; 3. The Mitochondrion, by D. B. Roodyn ; 4. The Chloroplast, by D. O. Hall and F. R. Whatley ; 5. Lysosomes, Phagosomes and Related Particles, by W. Straus ; 6. Membrane Systems, by E. Reid ; 7. Ribosomal Enzymes, by D. Elson ; 8. The Soluble Phase of the Cell, by N. G. Anderson and J. G. Green.   C. V. R.

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The subject-matter in this volume has been dealt with under the following titles : 1. Experimental Glomerulonephritis : Immunological Events and Pathogenetic Mechanisms, by Emil R. Unanue and Frank J. Dixon ; 2. Chemical Suppression of Adaptive Immunity, by Ann E. Gabrielson and Robert A. Good ; 3. Nucleic Acids as Antigens, by Otto J. Plescia and Werner Braun ; 4. *In vitro* Studies of Immunological Responses of Lymphoid Cells, by Richard W. Dutton ; 5. Developmental Aspects of Immunity, by Jaroslav Sterzl and Arthur M. Silverstein ; 6. Anti-antibodies, by Philip G. H. Gell and Andrew S. Kelus ; 7. Conglutinin and Immunoconglutinins, by P. J. Lachmann: C. V. R.

Salinity and Aridity. Edited by Hugo Boyko. (Dr. W. Junk Publishers—The Hague), 1966. Pp. viii + 408 p.w. frontispiece and 37 figs. Price $ 16.65.

In 30 to 40 years our earth will have to feed twice as large a population as today, and even today food production and its distribution is not sufficient for large parts of the world population. Of decisive importance to overcome the difficulties of the next few generations will be, besides the conquest of the vast potentialities of the oceans, the use of the deserts as agricultural areas. This book deals mainly with new approaches to the solution of the steadily growing water problem, and methods and results of recent experiments in various countries are presented here.

The arid and semi-arid areas cover a whole third of the landmasses of our globe. Wherever we are confronted with an arid climate, we frequently find as a consequence also saline soil and saline waters. But the problem of salinity is not restricted to arid zones. Broad coastal strips along all oceans and along the many salt lakes have to endure a continuous saltspray and only those living beings adapted to this kind of salinity can populate these salt-infested habitats.

The experiments described in this book show that the salt tolerance of most plant species is raised several times if the soil is dune sand. Salt water of high concentration and in some cases even sea-water can be used to productivize vast areas of shifting dunes and other sand-covered areas. A few examples from the many described in this book show the possible economic and social influence of these experiments.

The subject-matter in this book has been dealt with in three parts, *viz.*, I. General Part ; II. Principles and Experiments and III. Studies on Plant and Animal Life in Brine.   C. V. R.

Wave Phenomena. By Dudley H. Towne. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), 1967. Pp. xiv + 482. Price 72 sh.

Presenting a unified treatment of transverse waves on a string and acoustic and electromagnetic waves, this text aims at developing the orientation of theoretical physics with a minimal use of mathematics not already familiar to the student. The book stresses the mastery of certain mathematical techniques, emphasizing the wave properties common to sound and light, and showing how the mathematics unifies diverse physical situations in which the wave equation plays a role.

The contents of this book are : 1. Transverse Waves on a String ; 2. The Acoustic Plane Wave ;. Boundary Value Problems ; 4. Energy in a Sound Wave ; Isomorphisms ; 5. Experimental Aspects of Acoustics ; 6. The Electromagnetic Plane Wave ; 7. Analytical Description of Polarized Electromagnetic Plane Waves ; 8. The Production and Detection of Linearly Polarized Light ; 9. The Production and Detection of Elliptically Polarized Light ; 10. Additional Optical Properties of Matter ; 11. Interference Pattern from a Pair of Point Sources ; 12. Continuous Distributions of Coherent Sources ; the Fraunhofer Approximation ; 13. Fresnel Diffraction ; 14. The Double Slit ;

Multiple-slit Arrays; Diffraction Gratings; 15. Waves Confined to a Limited Region; 16. Waves in a Dispersive Medium; 17. The Acoustic Wave Equation in Three Dimensions.

<div align="right">C. V. R.</div>

Elements of Organic Chemistry. By Corwin and Bursey. (Addison Wesley Publishing Company, Inc., 10-15 Chitty Street, London W. 1), 1966. Pp. xviii + 746. Price $ 9.50.

The developments of the past century in the field of organic chemistry have matured the basic reasoning of the science so that an organization based on the principles of classification of compounds now appears outmoded. Accordingly, the authors of the present text have abandoned the traditional organization. Instead, they have adopted the point of view that organic chemistry has progressed to the point where it can be regarded as essentially a deductive science with a body of principles which can be taught to the beginner and which will permit him to organise for himself those portions of the tremendous literature of the field that he will use later. The plan of organization of the book has been according to the ideas rather than according to classifications of substances.

The purpose of this book is to concern itself with the application to the field of organic chemistry of the central theme of science, the scientific method of reasoning.

The contents of this have been dealt with in Book 1 and Book 2. Book 1 contains the following five parts: 1. The Structural Problem of Organic Chemistry; 2. The Basic Reasoning Underlying Organic Structures; 3. Elements of Chemical Geometry; 4. Some Basic Methods for Structural Determination; and 5. Structures of Some Natural Products. Book 2 contains the following seven parts: 1. Elements of Chemical Bonding; 2. Chemical Tools for the Investigation of Reaction Mechanisms; 3. Some Specific Mechanisms in the Aliphatic Series; 4. Some Specific Mechanisms in the Aromatic Series; 5. Some Mechanisms Applying to Both Aliphatic and Aromatic Systems; 6. Further Applications of Spectroscopy and 7. Epilogue.   C. V. R.

Rothamsted Experimental Station: Report for 1966. Pp. 411. Price £ 1 (Post free from the Librarian, Rothamsted Experimental Station, Harpenden, Herts, England).

The Annual Report of the Rothamsted Experimental Station for the year 1966 comprises (*i*) the General Report by the Director Dr. F. C. Bawden, F.R.S., (*ii*) the Departmental Reports from the dozen departments of the Station, (*iii*) Reports of the Field Experiments at Rothamsted, Woburn and Saxmundham, and (*iv*) Abstracts of over 250 research papers published by the Station during the year.

Reporting on the condition of crops, the General Report points out that watering at a critical time prevented wheat from developing the condition known as "scorch", and confirmed its ability to control common scab of potatoes. Late-sown crops of wheat varieties, especially on the less fertile fields, were greatly damaged by wheat-bulb fly. Early sowing was not, however, a safeguard everywhere. While at Rothamsted it could escape major damage by the pest, at Saxmundham wheat sown in October was too damaged to yield well.

The search for a seed-dressing to replace the chlorinated hydrocarbons is showing promise of success, for in soils where 80% of the shoots from untreated seed were attacked by wheat-bulb fly, only 12–20% of the shoots were attacked from seeds treated with carbophenothion. It was found that spraying spring wheat with the dwarfing compound CCC (2-chloroethyl-trimethyl-ammonium chloride) increased the yield by 2–6 cwt/acre. Soil disinfection with fungicides or nematicides showed increased yields in trial experiments, but its application to arable crops will be under prohibitive costs, and besides the benefits from some last only for one season.

On fertilizer use the Report says that the advantages from the cheapness of urea as a nitrogen fertilizer can be offset by the fact that it often damages seedlings, and that on some soils it decomposes quickly and ammonia is lost to the air. Urea-phosphate was free from these defects and was found to be as effective a nitrogen fertilizer as ammonium nitrate for wheat and grass.   A. S. G.

Essentials of Basic Mathematics. By A. J. Washington, H. R. Boyd and S. H. Plotkin. (Addison-Wesley Publishing Co., Inc., West End House, 11, Hills Place, London W. 1, England), 1967. Pp. ix + 292. Price 42 *sh.*

This is an elementary book on mathematics suitable for high schools. The approach is informal and intuitive. Topics include arithmetic, algebra, trigonometry and geometry.

<div align="right">A. S. G.</div>

A Hand-Book of Chemistry and Physics. Edited and Compiled by C. N. R. Rao, M. V. George, J. Mahanty and P. T. Narasimhan. [Affiliated East West Press (P) Ltd., C. 57, Defence Colony, New Delhi-3], 1967. Pp. 364. Price Rs. 8·00.

The Hand-book is comprehensive and it provides a wealth of data for ready reference. It is indispensable for students of chemistry and physics.

The editors deserve congratulations, and considering the arduous efforts involved in such a compilation, and also considering the frequent use the book will be put to, the reviewer feels that the size of type used and the general get-up could have been better. But the compilers' object is to price the publication low so as to bring it within the reach of the student buyers.

A. S. G.

Introduction to Vector Functions. By J. A. Hummel. (Addison-Wesley Publishing Company, Inc., West End House, 11, Hills Place, London W. 1, England), 1967. Pp. x + 372. Price 53 *sh.*

For an efficient application of mathematical techniques in different areas of physical science and engineering it is necessary that the student should have a clear insight into some of the fundamental mathematical facts upon which these techniques are based. Linear algebra and the calculus of functions of several variables are topics of applied interest to scientists and engineers. These are discussed in this volume in a more theoretical way than is customary in texts designed for engineers. The treatment is clear and modern and the book will form a suitable text for students of physics and engineering at graduate level.

The topics dealt with include vector spaces, linear transformations, determinants, matrices, functions of several variables, differentials, integration, curves and surfaces, and vector analysis dealing with Gauss theorem, Stokes theorem and Curvilinear co-ordinates. A. S. G.

Mathematics for the Physical Sciences. By L. Schwartz (Addison-Wesley Publishing Co., Inc., 10–15 Chitty Street, London W. 1), 1967. Pp. 357. Price $ 14.00.

Concerned with the mathematical methods of Physics this book deals with the following topics : Series and Integrals, Theory of distri-

butions, Convolution, Fourier series, Fourier transform, Laplace transform, Wave and heat conduction equations, Gamma function, and Bessel functions.

This is a revised and expanded translation of the original in French. A. S. G.

Elementary Calculus from an Advanced Viewpoint. By G. B. Thomas Jr., J. K. Moulton and M. Zelinka. (Addison-Wesley Publishing Co., Inc., 10-15 Chitty Street, London W. 1), 1967. Pp. 338. Price $ 9.50:

As indicated by the title the object of the authors is to provide a deeper understanding of elementary calculus. Fundamental ideas are carefully explained, and their applications to particular problems are emphasised. The treatment includes most of the standard material of differential and integral calculus for functions of one variable. Containing a large number of worked out problems and exercises, the book will provide a suitable text-book on elementary calculus to somophore students and teachers of the subject in pre-university classes. A. S. G.

Books Received

Introduction to Probability and Statistical Decision Theory. By G. Hadley. (Holden-Day Inc., 500, Sansome Street, San Francisco), 1967. Pp. x + 580. Price $ 11.85.

Introduction to Vector Functions. By J. A. Hummel. (Addison-Wesley Pub. Co. Inc., West End House, 11, Hills Place, London W. 1), 1967. Pp. x + 372. Price 53 *sh.*

Crop Responses to Water at Different Stages of Growth: By P. J. Salter and J. E. Goode. (Commonwealth Agri. Bureaux, Central Sales, Farnham House, Farnham Royal, Bucks), 1967. Pp. x + 246. Price 45 *sh.*

Set Theory for Mathematician. By J. E. Rubin (Holden-Day, 500, Sansome St., San Francisco), 1967. Pp. xi + 387. Price $ 11.85.

Essentials of Basic Mathematics. By A. J. Washington, H. R. Boyd and S. H. Plotkin. (Addison-Wesley Publishing Co., Inc., London N.W. 1), 1967. Pp. ix + 292. Price 50 *sh:*

Wave Phenomena. By D. H. Towne. (Addison-Wesley Publishing Co., Inc., West End House, London W. 1); Pp. xiv + 482. Price 72 *sh.*

The Decibel Notation and Its Applications to Radio Engineering and Acoustics. By V. V. L. Rao. (Asia Publishing House, Calicut Street, Bombay-1), 1967. Pp. xxiv + 211. Price Rs. 20.

ASPERAGENIN, A RARE TYPE OF STEROIDAL SAPOGENIN WITH 25-HYDROXYL GROUP

K. N. N. AYENGAR AND S. RANGASWAMI

Department of Chemistry, University of Delhi, Delhi-7

SMILAX ASPERA LINN. a drug used in Indian Medicine as a substitute for sarsaparilla is rich in saponins. The crude saponin obtained by the butanol method was hydrolysed with 2 N alcoholic HCl. Column chromatography of the crude genin mixture on neutral alumina yielded three crystalline compounds referred to as A, B and C (yields 0·01%, 0·0001% and 0·0007–·002% respectively).

Compound A, m.p. 200–3°, $[\alpha]_D - 68 \cdot °$*, $C_{27}H_{44}O_3$† was identified as sarsasapogenin (I) its acetate $C_{29}H_{46}O_4$, m.p. 141–3°, $[\alpha]_D - 60 \cdot 5°$, and its pseudogenin $C_{27}H_{44}O_3$, m.p. 166–8°, $[\alpha]_D + 4 \cdot 2°$ and the I.R. spectra of all the three compounds.

Compound B, m.p. 110–2°, $[\alpha]_D - 68 \cdot 0°$ analysed for $C_{27}H_{42}O_3$. With Ac_2O/Py (40°) gave an acetate m.p. 74–5°. The acetate gave pale yellow colour with tetranitromethane. The IR spectrum of B and its acetate showed absorptions at 852, 898, 921 and 989 cm.$^{-1}$, the density of the 921 cm.$^{-1}$ band being *ca.* four

900 cm.$^{-1}$ Thus asperagenin seems to belong to the *neo* (25 L) series.[1,2] The nature of the fifth oxygen atom as a tertiary hydroxyl was indicated by the observation that the TNM-negative diacetate gave a TNM-positive reaction product on heating with $POCl_3$-Py at 100°.

Asperagenin gave a digitonin precipitate 3–4 times more copious than sarsasapogenin under identical conditions. This is taken as evidence for a 3β-hydroxyl. A complex peak at *ca.* 1250 cm.$^{-1}$ in the IR spectrum of asperagenin diacetate indicated the presence of an axially oriented acetoxyl group at C_3.[3] Hence 5-H should be β-oriented.

Further information about the hydroxyl groups was obtained by a study of the NMR spectrum of asperagenin diacetate (taken in $CDCl_3$ on a Varian A-60 instrument with TMS as internal standard, *see* Fig. 1 and Table I) and comparing it with the data for sarsasapogenin acetate[4,3] (ref. 4 for the C_3-H and ref. 5 for the other protons).

TABLE I

NMR spectral data for sarsasapogenin acetate and asperagenin diacetate

(Values in ppm.)

	C–18	C–19	C–21	C–27	C–3H	C–3 O.Ac	C–26	C–16	C–6H	C–6 OAc
sasapogenin (I) acetate	0·77 (s)*	1·00 (s)	1·00 (d)*	1·08 (d)	5·1	2·06	3·3 – 3·95	4·4	··	··
eragenin (II) diacetate	0·77 (s)	1·04 (s)	0·95 (d)	1·14 (s)	5·33	2·06	3·28 – 3·96	4·4	4·84	1·96

* s = singlet; d = doublet.

es that of the 898 cm.$^{-1}$ band. Hence it is a steroid sapogenin of the *neo* series. It could be studied closely because of the extremely poor yields.

Compound C, m.p. 264–8, $[\alpha]_D - 135 \cdot 9°$ analysed for $C_{27}H_{44}O_5$. It was not identical with any of the known sapogenins and has been named asperagenin. It gave a diacetate with Ac_2O/Py (40°), m.p. 185–6°, $[\alpha]_D - 89 \cdot 0°$ analysing for $C_{31}H_{48}O_7$. Asperagenin and its diacetate show IR absorptions at *ca.* 850, 900, and 987 cm.$^{-1}$ The band at 920 cm.$^{-1}$ region *ca.* 3–4 times more intense than that at

The assignments of signals of asperagenin diacetate appearing at 0·77, 2·06, 4·4 and 3·28–3·96 ppm were made in analogy with the signals of protons in sarsasapogenin acetate. Of the remaining signals to be accounted for in asperagenin diacetate the singlet at 1·04 ppm should be due to C_{19} methyl protons; the explanation for down-field shift by 0·04 ppm is given later. The signal at 1·14 ppm may be ascribed with greater probability to the methyl protons of C_{27} and with lesser probability to those of C_{21}, the downward shift in either case being attributed to the influence of a tertiary hydroxyl group on the adjacent carbon atom, *viz.*, C_{25} or C_{20} respectively, and in either case the signal will be expected to appear as a singlet. However, a choice between the two

seems to be possible. It may be recalled that treatment of asperagenin diacetate with $POCl_3$-Py yielded a mixture of two dehydration products. The formation of two products can only be explained if the tertiary hydroxyl is at C_{25}, as it can give rise to both $\triangle$ 24 : 25 and $\triangle$ 25 : 26 compounds.[6] On the other hand a tertiary hydroxyl at C_{20} has been known to undergo dehydration in only one direction yielding a single product with the double bond at 20 : 21,[7] and this is not what has happened with asperagenin diacetate. The singlet at 1·14 ppm may therefore be assigned to C_{27} methyl protons. This conclusion seems to derive support from the fact that in the closely analogous case of reineckiagenin (25L, 5β-H-spirostan-1β, 3β, 25-triol) the C_{27} methyl signal has been assigned a value 1·27 ppm.[6]

asperagenin is inert towards periodate, positions 2 and 4 are ruled out. Position 15 is also ruled out because in the NMR spectrum the signal due to C_{16} a-proton appears at the same position as in sarsasapogenin acetate. The exact location of the hydroxyl was deduced by taking into consideration the difference in the chemical shift of the C_{19} methyl proton signal as between asperagenin diacetate and sarsasapogenin acetate. It is known that in steroids the resonance frequencies of C_{18} and C_{19} methyl protons are dependent on the nature and orientation of the substituents in rings A, B, C and D.[8] An equatorial acetoxy function if present at position 7 or 11 affects the resonance frequency of both the C_{18} and C_{19} methyls; if it is present at 6 only the C_{19} methyl signal is affected and its presence at C_{12} affects neither

FIG. 1. NMR spectrum of asperagenin diacetate.

Regarding the remaining hydroxyl group the appearance of four C-methyl peaks in the NMR rules out the presence of any primary hydroxyl. Its ease of acetylation suggests that it is most probably an equatorially oriented secondary hydroxyl. Of the various positions which could be considered for it position 1 is eliminated since it would make asperagenin identical with reineckiagenin, which is not the case. As

C_{18} nor C_{19} methyl signal. In asperagenin diacetate the signal due to proton at C_{18} appears in the same position as in sarsasapogenin acetate but the signal due to C_{19} methyl which is at 60 cps in sarsasapogenin acetate has been shifted by 2·4 cps in the case of asperagenin diacetate. Hence the acetoxy group does not seem to be at 7, 11 or 12 but at C_6. This would also explain the value 5·33 ppm for the proton

at C_3 of asperagenin diacetate as compared to 5·1 ppm for sarsasapogenin acetate. The signal at 1·96 ppm is due to the acetoxy protons at C_6 and the signal at 4·84 ppm to the proton α to this acetoxyl. Thus asperagenin may be assigned the structure of 25L, 5β-H-spirostan-3β, 6α, 25-triol (II). The only point for which it has not been possible to find an explanation is the upfield shift of the C_{21} protons signal by 0·05 ppm.

The molecular rotation of asperagenin diacetate seems to support the above structural assignment.

Calculated :		M_D
Sarsasapogenin acetate[9]		— 323°
Contribution of 6α-OAc[10]		— 87°
Contribution of equatorial	25-OH	
Reineckiagenin diacetate[6]	— 436°	
Rhodeasapogenin diacetate[11]	— 366°	
	— 70°	— 70°
		— 480°
Observed :		— 473°

(I) R = R$_1$ = H, Sarsasapogenin
(II) R = R$_1$ = OH, Asperagenin

Asperagenin thus belongs to the rare type of 25-hydroxy steroidal sapogenin of which the only representative so far known is reineckia-genin.[6]

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ULTRASONIC VELOCITY AND ABSORPTION MEASUREMENTS IN BINARY LIQUID MIXTURES

M. VENKATESHWARLU AND G. SIVARAM SASTRY

Department of Physics, Osmania University, Hyderabad-7 (A.P.)

RAO AND RAO[1] reported the variation of ultrasonic velocity with molar concentration in binary liquid mixtures of pyridine with the carboxylic acids. Tunin et al.[2] studied the ultrasonic velocity and absorption in pyridine-benzene liquid mixture and showed a similar variation of these values with concentration. As pyridine is a polar liquid with a large dipole moment, a study of binary liquid mixtures

with pyridine as a common component, is likely to throw light on the nature of molecular association in these liquids. The authors have therefore taken up the study of the binary liquid mixtures of pyridine with benzene, carbon tetrachloride, carbon disulphide and chloroform.

Ultrasonic pulse technique as developed by Pinkerton,[3] was used to obtain the absorption

values at different concentrations with an error of ± 3%. Velocity measurements were made with a double crystal variable path interfero-meter with ± 1 m/s. accuracy. The velocity and absorption measurements of pyridine-benzene, pyridine-chloroform and pyridine-carbon tetrachloride were made at 8·9 mc./s. and for the pyridine-carbon disulphide mixture at a frequency of 2·95 mc./s.

DISCUSSION OF RESULTS

Figures 1, 2, 3 and 4 give the variation of velocity, adiabatic compressibility and absorption (α/f^2) values with increasing concentration of pyridine in the four liquids mentioned. The velocity, compressibility and absorption values show a smooth variation in pyridine-carbon

tetrachloride mixture. But in the other three liquid mixtures, there is a small decrease in velocity at very low concentrations, followed by a smooth rise at higher concentrations. The velocity fall is particularly steep in the pyridine-benzene liquid mixture. The compressibility values show a corresponding maximum at the same concentrations.

The occurrence of a small decrease in velocity when a polar liquid is dissolved in a non-polar solvent has been widely reported. The absence of a velocity dip in pyridine-carbon tetrachloride is a departure from this behaviour. It can also be seen that the compressibility of pyridine-carbon disulphide shows a second maximum at 0·64 mole/l. concentration and a similar maxi-

FIGS. 1–4. Fig. 1. Carbon tetrachloride-pyridine.   Fig. 2. Benzene-pyridine.   Fig. 3. Carbon disulphide pyridine.   Fig. 4. Chloroform pyridine.

mum is also found for pyridine-chloroform mixture at 0·42 mole/l. concentration.

Both the pyridine-carbon disulphide and pyridine-chloroform liquid mixtures exhibit a small maximum in absorption at about 0·2 mole/l. concentration of pyridine. Pyridine-benzene mixture, however, does not show up this maximum. Working on binary liquid mixtures with aniline as a common component, the authors[4,5] have found that an absorption maximum occurs around 0·3 mole/l. concentration of aniline, in aniline-carbon disulphide, aniline-iso propyl alcohol and aniline-xylene mixtures. That an absorption peak should occur at the same concentration of the solute, both for pyridine and aniline, indicates that this may be due to a structural rearrangement in these solutions characterised by the special nature of the solutes employed. Spectroscopic evidence (Puranik *et al.*[6]) indicates formation of N-H bonds and complexes in pyridine solutions. As both pyridine and aniline are strong

polar liquids characterised by N-H bond association, the effects observed in absorption may be attributed to the molecular association brought about by N-H bond formations in these solutions. It is still not very clear, how an absorption maximum appears at the same concentration in carbon disulphide for both these solutes.

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SORPTION-DESORPTION HYSTERESIS OF WATER ON GELATIN

K. SUBBA RAO AND BHAGWAN DAS

Chemistry Department, Birla Institute of Technology and Science, Pilani, Rajasthan

NONRIGID sorbents like rice,[1,2] proteins[3,4] and gums[5,6] have shown a unique behaviour in the sorption and desorption of solvating liquids like water. Either there is no hysteresis effect or the hysteresis loop initially exhibited decreases in size and finally disappears on successive sorptions and desorptions. Gelatin made by Difco Laboratories, Michigan, U.S.A., has shown certain interesting characteristics in the sorption and desorption of water and these are reported in this article.

Making use of the quartz fibre spring balance, a series of sorptions and desorptions were carried out at 35° C. Difco gelatin shows the hysteresis effect and this persists in the subsequent cycles. The study was continued up to 12th cycle. The first and twelfth hysteresis loops are shown in Fig. 1. The hysteresis loop changes in shape and size on successive sorption and desorptions. In the low and high vapour pressure regions of the first cycle, there are loops. In the middle, the sorption and desorption curves are almost coincident. It is a "split hysteresis loop". On successive sorptions and desorptions, the desorption curve shifts away from the sorption curve. This shift is

very prominent in the low vapour pressure region of the hysteresis loop in the 12th cycle. There is also a decrease in total sorptive capacity from 116·4% of the 1st cycle to 104·3% of 12th cycle. Part of the sorption curve in the high vapour pressure region has slightly shifted towards the pressure axis.

FIG. 1. Sorption-desorption hysteresis of water on gelatin (difco) at the 1st and 12th cycles.

The cavity theory of hysteresis and its application to explain the various aspects of

hysteresis such as permanence, reproducibility, drift and disappearance have been amply elaborated in the earlier publications. In the light of the cavity theory, interpretation of the characteristic changes shown by Difco Gelatin leads to interesting conclusions.

During sorption the filling of cavities is progressive and proceeds from the neck to the body of the cavity. Whereas during desorption emptying of the cavity is sudden and abrupt. The cavity gets emptied when the neck is emptied. The slight shift of the sorption curve and the decrease in total sorptive capacity indicate that the cavities have decreased in size. The shift of the part of desorption curve in low pressure region and consequent widening of the hysteresis loop indicate that the entrapping effect of the cavities has increased.

The difference between the body radius and neck radius of cavity is a measure of the volume of liquid entrapped. The entrapped volume increases as this difference increases. At the end of each sorption, gelatin swells with the water taken up at saturation pressure. During desorption, gelatin shrinks and the cavities collapse in stages. The decrease in the total sorptive capacity and increase in the entrapping effect in the low vapour pressure region suggest that the cavity necks are more constricted than the body of the cavity. Why the necks are more constricted than the body is still an open question. In a swelling system in a solvating liquid, the entry of the liquid into the interior is a slow process. The hydration and swelling may not be uniform. During desorption, the swollen sorbent shrinks. Swelling and shrinkage, if non-uniform, result in localised stresses and strains and these affect the extent of collapse of the cavities and their necks.

The nature of the changes observed in Difco Gelatin in the 12th cycle of sorption and desorption is a particular stage in the continuous process. The study lasted over 8 months. If further sorptions and desorptions of water on the gelation were continued, the cavities and their necks would further shrink and finally collapse and the hysteresis loop would disappear.

Unlike many other swelling sorbents which have been studied, Difco Gelatin has behaved in a unique way. The changes have been explained satisfactorily in the light of the cavity concept in conjunction with the hydration and swelling of gelatin. The treatment however is qualitative. No other theory of hysteresis advanced so far can account for all the changes shown by Difco Gelatin.

In an earlier investigation,[3] gelatin of Merck Gold Label quality has shown no hysteresis effect at all in the first two cycles of sorption and desorption whereas Difco gelatin has behaved differently. This raises the possibility of varietal difference in gelatin influencing sorption-desorption hysteresis. The problem is being investigated.

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FOSSIL ANGIOSPERMIC REMAINS FROM NEAR TYAJAMPUDI IN THE WEST GODAVARI DISTRICT OF ANDHRA PRADESH

C. G. K. RAMANUJAM

Department of Botany, Osmania University

AND

M. RAGHU RAM RAO

Department of Botany, New Science College, Hyderabad

THE present communication records the occurrence of fossil angiospermic remains collected recently (March, 1967) from a new fossiliferous locality, 1½ miles east of Tyajampudi (81° 31′ 30″ : 16° 58′ 30″, topo-sheet No. 65H/9) in the West Godavari District of Andhra Pradesh.

The fossils, preserved almost exclusively as impressions or compressions, are found in khakhi or brownish coloured hard, compact and well-laminated shales. The shale bed only a few feet thick, overlies a pebble bed and both these are associated with the Rajahmundry

sandstones which constitute the prominent geological formation all around the area. The sandstones themselves overlie the igneous Deccan traps.

FIGS. 1–7. Fig. 1. *Phyllites* Sp. 1. Figs. 2–4. *Phyllites* Sp. 2. Fig. 5. *Phyllites* Sp. 3. Fig. 6. *Phyllites* Sp. 4. Fig. 7. Seed-like organ. (Figs. 1–5, × 1; Figs. 6–7, × 2.)

3

As a rule, the fossils are fragmentary and one has to break a number of shales along their bedding planes before coming across a tolerably complete leaf impression. None of the compressions found show any traces of carbonaceous films, hence it could not be possible to recover their cuticles.

The following is the description of some of the fairly preserved fossils. Pending a detailed investigation of the fossil flora, no serious attempt is made in the present article to comment upon the exact botanical affinities of these fossils. Accordingly all the leaf impressions have been included under the non-commital form genus *Phyllites*.

Phyllites *Sp. 1 (Fig. 1).*—The specimen shows two nearly compltee leaf impressions. Both these leaves are similar and probably belonged to the same plant. They might as well represent the leaflets of a compound leaf (?). Leaves seem to be elliptical, sessile or with short, inconspicuous petiole, margin entire, venation pinnately reticulate with a clear midrib and fairly distinct lateral veins, the latter set about 2 mm. apart and almost reaching margin. Clear network seen in between lateral veins. Size of preserved part 3-3·5 × 1·5 cm.

Of these two leaves one seems to be preserved on its lower and the other on its upper facet.

Phyllites *Sp. 2 (Figs. 2-4).*—The leaves in Figs. 2, 3 and 4 are all similar in their characters and probably belonged to the same plant. Of these, the leaves shown in Figs. 2 and 3 are nearly complete specimens while the one in Fig. 4 (lower one) is very much incomplete. The description given is based mostly on the former.

Leaves fairly large about 6·5 × 3 cm. or even larger, probably petiolate (?), margin entire but not uniformly preserved. The margin and lamina give an indication that these might have been fungal infected prior to fossilization. Shape oval, venation pinnately reticulate with a prominent midrib. Primary lateral veins sub-opposite, given off at an angle of 30–40° almost

reaching margin and set 4–7 mm. apart; secondary veins arise almost at right angles from primary ones. Clear reticulum of veinlets in bteween secondary veins.

Figures 2 and 3 also show a small stem impression each, by the side of the leaf impression. In both the cases the stem pieces are longitudinally ribbed owing to ridges and furrows. No nodal region, however, is seen.

Phyllites *Sp. 3 (Fig. 5).*—The specimen shows a single leaf preserved almost completely.

Leaf sessile or with an extremely short petiole (?), 4·5 × 1·5 cm., ovate with a broad base and gradually tapering apex. Margin entire, tip acute, venation pinnate, midrib distinct, lateral veins poorly preserved.

Phyllites *Sp. 4 (Fig. 6).*—The specimen shows a small leaflet, completely preserved. Leaf 2·5 × 1 cm., elliptical, almost sessile or with a very short petiole, margin entire, tip acute, venation pinnately reticulate. Midrib very prominent being considerably thick, lateral veins fine 1·5 mm. apart not quite reaching margin.

This may probably represent the leaflet of a compound leaf of Leguminosæ.

Figure 7.—The specimen is a compression of a more or less oval, probably flat seed-like organ 0·8 × 0·5 cm. Wall considerably thick and homogeneous. Inside the wall is a raised cushion-like part, at one end of which (upper end in the photo) can be seen a small but conspicuous broadly triangular depression. The cushion-like part and the prominent depression, might represent the remnants of the embryo, the former probably constituting the cotyledonary zone.

These fossils can be attributed to the dicotyledonous members of angiosperms, and they provide unequivocal palæobotanical evidence for the Tertiary age of the Rajahmundry sandstone formation.

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LETTERS TO THE EDITOR

FINE STRUCTURE ANALYSIS OF THE C_1–X_2 ULTRAVIOLET SYSTEM OF BiF

THE spectrum of Bismuth monofluoride is known to consist of a number of band systems designated as A–X_1, B–X_1,* C_1–X_2, C_2–X_3 and C_3–X_1. As the A–X_1, B–X_1 and C_3–X_1 systems were obtained in absorption, it is known that X_1 is the ground state of the BiF molecule. From a rotational analysis of the (1, 0), (0, 0), (0, 1), (0, 2) and (0, 3) bands of the A–X_1 system, Rao and Rao[1] have shown that the transition of the A–X_1 system is a 0^+–0^+ which is the case (c) equivalent of $^3\Sigma^-$–$^3\Sigma^-$. The X_1 level was thus attributed by them to the $^3\Sigma^-$ (0^+) state of the ground state electron configuration

$$(z\sigma)^2 \ (y\sigma)^2 \ (x\sigma)^2 \ (w\pi)^4 \ (v\pi)^2 . \ .^3\Sigma^-, \ ^1\Delta, \ ^1\Sigma^+.$$

The first excited level A was attributed to the $^3\Sigma^-$ (0^+) state of the first excited electron configuration

$$(z\sigma)^2 \ (y\sigma)^2 \ (x\sigma)^2 \ (w\pi)^3 \ (v\pi)^3 \ . \ . \ . \ ^3\Sigma^-.$$

The levels X_2 and X_3 were tentatively attributed by Rao and Rao to the $^1\Delta$ and $^1\Sigma^+$ states of the ground state configuration.

The ultraviolet systems C_1–X_2, C_2–X_3 and C_3–X_1 consist of bands degraded to shorter wavelengths in the regions λ 3250–3050 Å, λ 2850–λ 2650 Å and λ 2350–2250 Å respectively. Each of the systems C_1–X_2 and C_3–X_1 consists of single-headed bands, while the C_2–X_3 system consists of double-headed bands. By exciting the spectrum of BiF molecule in a high-frequency discharge from a 500-Watt oscillator working at a frequency of 40 M.C.P.S., it has become possible to develop the rotational structure of the bands (0, 0), (0, 1), (0, 2) and (0, 3) of the C_1–X_2 system, using the first order of a 21 ft. concave grating spectrograph (dispersion 1·25 Å/mm.). Each of these bands is found to exhibit a simple structure consisting of single P and R branches. From a detailed rotational analysis of these bands, the following rotational constants for the upper and lower states have been determined and are given in Table I.

The bands seem to involve a transition in which $\Delta\Lambda = 0$. Thus, if X_2 level arises from a $^1\Delta$ term as was suggested by Rao and Rao, the transition of the C_1–X_2 system is a $^1\Delta$–$^1\Delta$. On the other hand, if the X_2 level arises from a $^1\Sigma$ term, the transition of the C_1–X_2 system is a $^1\Sigma$–$^1\Sigma$. As the P and R branches are not

TABLE I

Molecular constants of the upper and lower states of BiF molecule

Upper state C_1	Lower state X_2
$B_0' = 0·269_0$ cm.$^{-1}$	$B_e'' = 0·253_5$ cm.$^{-1}$
$\alpha_e' = \ldots$	$\alpha_e'' = 0·0018$ cm.$^{-1}$
$D_0' = 0·65 \times 10^{-6}$ cm.$^{-1}$	$D_e'' = 0·51 \times 10^{-6}$ cm.$^{-1}$
$\beta_e' = \ldots$	$\beta_e'' = 0·05 \times 10^{-6}$ cm.$^{-1}$
$r_0' = 1·897 \times 10^{-8}$ cm.	$r_e'' = 1·954 \times 10^{-8}$ cm.
$I_0' = 104·031 \times 10^{-40}$ gm. cm.^{2}	$I_e'' = 110·38 \times 10^{-40}$ gm. cm.^{2}

resolved at low J values under the dispersion used, it is not possible to conclude which of the two alternatives applies for the transition of the C_1–X_2 system. Details will be published shortly.

Spectroscopy Lab.,   P. SREENIVASA MURTY.
Dept. of Physics,   P. TIRUVENGANNA RAO.
Andhra University,
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Z-DEPENDENCE OF K-SHELL BOUND ELECTRON SCATTERING CROSS-SECTIONS

IN the case of free-electron scattering cross-section there exists a direct proportionality with Z^1 the atomic number of the element. The present note concerns the Z-dependence of the bound electron scattering cross-section in which we have used our experimental data[1-3] on K-shell electron scattering cross-sections at 320, 662 and 1002 keV gamma energies in Pb, Ta, Sm and Sn.

A simple Z-dependence of the form Z^n is assumed where n is the exponent to be determined to study the dependence of the bound electron scattering cross-section on atomic number at various incident gamma energies and angles of electron emission. Utilising our experimental results[1-3] a least square fit is made and n is calculated at each energy and angle. The results are given in Table I.

In the case of free-electron scattering cross-section the value of n is unity at all incident gamma energies and angles of electron emission. It can be seen from Table I that n in the case of bound electron scattering cross-section is

Angle in degrees	Energy in keV		
	320	662	1002
30	..	0·86	..
40	..	..	0·94
45	0·86	0·92	..
60	0·91	0·97	0·98
90	0·93	1·03	1·02
110	0·97	..	..
128	..	..	1·05
130	..	1·07	..

variable and increases with angle. Its value is smaller than unity at 320 keV gamma energy at all angles and at 662 and 1002 keV gamma energies up to 60°. This implies that the Z-dependence of bound electron scattering cross-section is smaller than that of free-electron scattering cross-section at these energies and angles ; *per contra* at 662 and 1002 keV gamma energies above 60° the Z-dependence of the bound electron scattering cross-section is greater than that of free-electron scattering cross-section.

The Laboratories for   A. RAMALINGA REDDY.
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PRELIMINARY CRYSTALLOGRAPHIC INVESTIGATIONS ON THE RACEMIC ISOMERS OF SOME DIARYLBIPHTHALIDYLS

IT is well known that o-benzoyl benzoic acids and their acid chlorides are converted into 3, 3'-diarylbiphthalidyls by the action of a variety of reducing agents like hydroiodic acid, hydrochloric acid, aluminium and sulphuric acid. Theoretically, these biphthalidyls can exist in two isomeric forms, *viz.*, the meso and the racemic forms. Detailed X-ray investigation on the structures of the two isomeric forms is of interest mainly because they are formed in unequal proportions.

The isomeric mixture of 3, 3'-diphenyl-bi-3-phthalidyls was obtained from the reaction of o-benzoyl benzoic acid and sodium iodide in

acetone. The corresponding bromo and chloro derivatives were obtained from similar reactions of o-(p-bromobenzoyl) benzoic acid and o-(p-chlorobenzoyl) benzoic acid respectively. The mixture of biphthalidyls formed in the above reactions consisted of two components in the ratio 70 : 30. The components were separated by fractional crystallisation. X-ray investigations on the crystal and molecular structures of the bromo and the chloro derivatives of the more abundant isomer have showed them to correspond to the meso isomeric form. Details of these investigations have already been reported.[1-3] The present note reports the preliminary crystallographic investigations on the less abundant racemic isomers.

The unit cell dimensions of the crystals of racemic, 3, 3'-diphenyl-bi-3-phthalidyl and their chloro and bromo derivatives were determined from oscillation and Weissenberg photographs taken about crystallographic axes using CuKα radiation. The space groups were deduced from the symmetry of and the systematic absences in the respective X-ray diffraction patterns. The crystal and physical data for all the three compounds are summarized in Table I. The densities of the unsubstituted compound and the chloro derivative were determined by flotation in aqueous potassium iodide solutions and that of the bromo derivative was obtained by flotation in a mixture of bromoform and carbon tetrachloride.

During the recording of the X-ray diffraction patterns it was found that after a few hours of exposure to X-rays the samples disintegrated into powders. Samples crystallized from different solvents were also tried, but this feature persisted throughout. However, earlier it was found that the crystals of the corresponding meso isomers withstood X-ray exposure for several hundreds of hours without any damage to them. This feature probably indicates the inherent instability of the racemic forms. It is likely that this instability is due to the less sterically favoured molecular configuration in the racemic forms compared to that in the meso forms. Any final conclusion, however, can be drawn only after the complete elucidation of the structures of the racemic isomers.

TABLE I

		Unsubstituted $C_{28}H_{18}O_4$	Bromo derivative $C_{28}H_{16}O_4Br_2$	Chloro derivative $C_{28}H_{16}O_4Cl_2$
Formula weight	..	418·42	576·24	487·32
Cell parameters	a ..	9·40 ⎫	12·58 ⎫	9·17 ⎫
	b ..	14·87 ⎬ ±0·02 Å	22·38 ⎬ ±0·02 Å	11·76 ⎬ ±0·02 Å
	c ..	7·91 ⎭	16·68 ⎭	15·04 ⎭
	α ..	90° 57' ⎫	..	99° 6' ⎫
	β ..	100° 6' ⎬ ±1°	..	91° 42' ⎬ ±1°
	γ ..	90° 12' ⎭	..	112° 15' ⎭
Unit cell volume, U	..	1087·61 Å³	4696·11 Å³	1482·85 Å³
Space group	..	P1 or P$\bar{1}$	Pbca	P1 or P$\bar{1}$
Density Dm	..	1·310 gm. cm.⁻³	1·664 gm. cm.⁻³	1·120 gm. cm.⁻³
Dc	..	1·278 gm. cm.⁻³	1·630 gm. cm.⁻³	1·091 gm. cm.⁻³
Molecules per unit cell, Z	..	2	8	2
Linear absorption coefficient for X-rays ($\lambda = 1\cdot542$ Å)		6·98 cm.⁻¹	49·99 cm.⁻¹	26·96 cm.⁻¹
Melting point	..	270°C.	226-8°C.	235° C.

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D₂O SOLVENT EFFECT ON RADIATIONLESS RATE CONSTANT OF TRIPLET EMISSION IN FLUORESCEIN DYE

THE triplet state lifetimes and ratio of triplet and singlet emission yields (Φ_p/Φ_f) of aromatic hydrocarbons are greatly enhanced for perdeuterated compounds.[1-4] Similar increase has been observed in both lifetime and intensity of emission in rare earth and uranyl ions.[5-8] The longer lifetime of perdeuterated compounds is attributed to decrease in radiationless transitions from excited triplet to ground state singlet.[2,9]

We have observed an increase in phosphorescence lifetime and intensity of fluorescent sodium when D₂O is used as solvent in place of H₂O. Such an effect due to solvation does not seem to have been reported in organic phosphors earlier. A highly alkaline dilute ($\sim 5 \times 10^{-5}$ M) fluorescein sodium solution pH $\sim$ 13 freezes into a glass at 80° K and emits monomer fluorescence and phosphorescence.[10] The phosphorescence emission in D₂O solution has a lifetime 1·8 times longer than in H₂O. Similarly (Φ_p/Φ_f) ratio increases approximately by 1·7. Within the experimental errors of ±10%, the two values are the same. In concentrated sulphuric

acid solution of the dye with same amount of H₂O, or D₂O similar results are obtained. These data are given in Table I. The room temperature emission efficiency which consists only of fluorescence is, however, not affected. This is in conformity with the observations made by earlier workers in deuterated compounds.[11]

TABLE I

Ratio of phosphorescence lifetime (τ_{pD}/τ_{pH}) and phosphorescence yields (Φ_{pD}/Φ_{pH}) in D₂O and H₂O solutions of fluorescein sodium at 80° K.

Matrix	$\left(\dfrac{\Phi_{pD}}{\Phi_{pH}}\right)$	$\left(\dfrac{\tau_{pD}}{\tau_{pH}}\right)$	Emitter[13]
Highly alkaline ..	1·7	1·8	Double negative ion
Concentrated sulphuric acid	1·3	1·4	Single positive ion

From the well established rate equation,[12]

$$\Phi_f = \frac{k_f}{k_f + k_{qf} + k_{1S}}, \quad \frac{\Phi_p}{\Phi_f} = \frac{k_p.k_{1S}}{k_f(k_p + k_{qp})}$$

and $\tau_p = \dfrac{1}{(k_p + k_{qp})}$

where k_p, k_f, k_{qp}, k_{qf} and k_{1S} refer respectively to radiative phosphorescence rate $(T_1 \to S_0)$, radiative fluorescence rate $(S_1 \to S_0)$, phosphorescence quenching rate $(T_1 \to S_0)$, fluorescence quenching rate $(S_1 \to S_0)$ and intersystem crossing rate $(S_1 \to T_1)$. Since Φ_f does not change, either k_{qf} decreases exactly by the same magnitude as k_{1S} increases or only k_{qp} decreases. The latter possibility obviously appears more real.

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SPURIOUS NQR SIGNALS

A NUMBER of chlorates, bromates and iodates have been previously investigated and most of the substances usually give strong NQR signals.[1,2] During our programme of investigating the solid state by Nuclear Quadrupole Resonance (NQR) techniques we observed peculiar signals in cesium chlorate, cesium bromate and ammonium iodate. Similar peculiar signals were reported in 4-chloro 2-nitro aniline.[3] The experimental techniques used were the same as reported earlier.[4,5] These signals are fairly strong and are spread over a wide frequency range unlike the pure NQR signals which occur at a single characteristic frequency. These are not effected by the magnetic field.

In cesium chlorate these signals occur in the frequency region of 24–35 Mc./s. We also investigated the signals from liquid air temperature to room temperature. Below –42° C. the signals disappeared. No known phase transition exists for this compound.

In cesium bromate a single resonance frequency was reported at 145·662 (at liquid air temperature) by Schawlow.[6] Our observations show that in this compound strong signals occur in the frequency region 135–165 Mc./s.

and also in the frequency region 267–295 Mc./s. with reduced intensity (observations made at room temperature).

In ammonium iodate we observed strong signals in the regions 135–165 and 267–295 Mc./s. No signals have been reported in this compound previously.

Another peculiarity we observed during this investigation is that the signals are more intense when the sample is placed in the region of strong RF electric fields, *i.e.*, when the substance is placed at the voltage antinode of the Lecher line system or when it is placed near the condenser for low frequency oscillators. It is not possible to explain the occurrence of these signals. One can only say that these spurious signals may be due to the piezo-electric nature of the substance. It may also be pointed out that these signals though spurious and not directly connected with the quadrupolar property of the nuclei will serve as a good test for testing the performance of the low and high frequency NQR oscillators, due to their sharp and intense nature.

We also carried out a fairly intense search for the NQR signals in silver iodate, barium iodate and cesium iodate in the frequency region of 130–300 Mc./s., where most of the iodate signals occur. But we could not observe any signals in these compounds in this frequency range. We employed oscilloscopic detection only.

Department of Physics, MRS. K. SYAMALAMBA.*
Andhra University, G. CHAKRAPANI.
Waltair, C. R. K. MURTY.
October 9, 1967.

* Department of Physics. College of Engineering, Andhra University.

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GRAVIMETRIC ESTIMATION OF PALLADIUM (II) WITH RESACETOPHENONEOXIME

[illegible]

[illegible] with Pd (II) [illegible] The precipitate was found to be quantitative. [illegible] 24·28% of Pd. [illegible]

[illegible] as a reagent. [illegible]

The precipitate was filtered through a weighed sintered glass crucible (G 4) and washed with hot water till free from the reagent (the reagent gives with ferric chloride a purple colour). The precipitate was dried to constant weight at 110° C. and weighed.

Typical results obtained with known amounts of palladium are given in Table I.

The experimental values are in close agreement with the calculated value for Pd $(C_8H_8O_3N)_2$.

Estimation of Palladium (II) in Presence of Nickel.—Palladium chloride solution containing a known amount of palladium was treated with a solution containing [illegible] of nickel in each case, acidified with 1·0 N hydrochloric acid, diluted to yield a 0·1 N acid solution and the palladium precipitated as the oximate. The estimation was completed as above. Typical results are recorded in Table II.

TABLE I

S. No.	Pd taken (mg.)	Complex (mg.)	% Pd in complex		Error %
			Experimental	Theoretical	
1	31·10	127·7	24·35	24·28	+0·29
2	26·26	108·0	24·32	,,	+0·16
3	17·78	73·3	24·26	,,	−0·68
4	12·84	53·0	24·23	,,	−0·21
5	8·89	36·6	24·29	,,	+0·04

TABLE II

S. No.	Amount of Pd taken (mg.)	Amount of Pd found (mg.)	Error (%)
1	32·74	32·76	+0·06
2	24·56	24·58	+0·08
3	16·37	16·41	+0·25
4	12·28	12·27	−0·08
5	8·19	8·18	−0·12
6	4·09	4·10	+0·24

The results are reproducible with an error of ± 0·25% for amounts of Palladium (II) ranging from 4·0 to 33 mg. The reagent is readily prepared and is the least expensive compared with other reagents reported in the literature.

The author expresses his grateful thanks to Prof. E. Neelakantam for his guidance in the course of the work.

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S.V. University College,
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SOME N-THIOCARBAMYL DERIVATIVES OF 3-AMINO-4-HYDROXY COUMARIN

DERIVATIVES of 3-amino-4-hydroxy coumarin have been reported to possess antibacterial and antifungal properties by some workers.[1] This unit is also present in the antibiotic Novobiocin which has excellent antibacterial spectrum chiefly against gram-positive bacteria.[2] A number of thiourea derivatives are also found to possess marked antibacterial and fungicidal activities.[3]

It seemed of interest, therefore, to prepare compounds having both a thiourea and a 3-amino-4-hydroxy coumarin moiety, and to screen such compounds for antibacterial and antifungal activities. With this view, a few thioureas (I) from 3-amino-4-hydroxy coumarin[4] were prepared by refluxing it and an equivalent of aryl isothiocyanate in ethanolic solution. The required 3-amino-4-hydroxy coumarin was obtained by nitration of 4-hydroxy coumarin and subsequent reduction. Compounds thus prepared are described in Table I, all melting points are uncorrected.

TABLE I

I

No.	R	M.P. °C.	% Sulphur	
			Found	Required
1	C_6H_5	200[a]	10·00	10·22
2	$C_6H_4CH_3$ (o)	245[a]	9·53	9·81
3	$C_6H_4CH_3$ (m)	295	9·50	9·81
4	$C_6H_4CH_3$ (p)	200	9·62	9·81
5	C_6H_4Cl (o)	300	9·12	9·23
6	C_6H_4Cl (p)	288–90	9·20	9·23
7	C_6H_4oMe (o)	287	9·22	9·35
8	C_6H_4oMe (p)	300	9·21	9·35

Dept. of Chemistry, SATYENDRA KUMAR.
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COMPLEX COMPOUND OF CADMIUM (II) WITH 1-AMIDINO-2-THIOUREA

A SURVEY of the literature shows that there is no record of cadmium (II) complex of 1-amidino-2-thiourea. Ray and co-workers prepared cobalt (II and III), copper (II), nickel (II) and palladium (II) derivatives of 1-amidino-2-thiourea.[1-3] Nadkarni and Halder utilised this reagent for gravimetric and spectrophotometric estimation of few metals.[4] This note relates to the synthesis of cadmium (II) derivative of 1-amidino-2-thiourea (ATU).

For the preparation of the complex an ethanolic solution of cadmium (II) chloride monohydrate (1 mole) and the ligand (2 mole) was refluxed for half an hour. The separated yellow crystalline products were suction-filtered, washed with absolute alcohol and dried in air. The purity of the isolated product was established by estimating the elements. Cadmium was estimated as $Cd\ NH_4PO_4.H_2O$. Nitrogen was determined by semimicro Dumas combustion technique (Found: Cd, 36·4; N, 18·8; Cl, 23·2; S, 10·5%. Reqd. for [Cd $(C_2H_6N_4S)$ Cl_2], Cd, 37·2; N, 18·6; Cl, 23·5; S, 10·6%). The ligand (ATU) was prepared according to the method of Kurzer[5] (Found: N, 47·3; S, 27·0%. Reqd. for $C_2H_6N_4S$, N, 47·4; S, 27·1%). The magnetic moment of the complex was determined at room temperature by the Gouy method and the complex was found to be diamagnetic. The electrolytic conductance and molecular size could not be determined due to the poor solubility of the complex in common solvents.

On the basis of analytical data the compound has the formula $Cd\ (ATU)\ Cl_2$ and is only apparently tri-co-ordinated. The complex melts at a very high temperature beyond 300° C. and is insoluble in common organic solvents. Hence it is not definitely a monomer and can be assigned as polymeric tetrahedral structure, where 1-amidino-2-thiourea behaves as a monodentate neutral ligand. Recently Stephen and Townshend have also reported the unidentate character of 1-amidino-2-thiourea in a silver (I) complex.[6]

Inorganic Chem. Laboratory, A. SYAMAL.
University of Burdwan,
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SILICA CONTENT IN COCONUT (COCOS NUCIFERA) KERNEL AND WATER

... ... kernel
... ... number
water ... ... that
... ... determination
... ... between the
... ... and content in
... ... kernels and
... ... the work
... ... selected in
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... ... and the
... ... separately. A
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residue preserved for silica analysis. The kernel in small pieces is taken in a platinum ash and weighed, the mass is charred, ashed and processed as above.

The residues with the filter-paper are ashed in platinum crucibles. The ashes are evaporated[2] to dryness after adding 10 ml. instalments of 1 : 1 HCl, dehydrated, heated in a muffle furnace at 1000° C. for 30 minutes and cooled and weighed to constant weight ($w1$). The residues are then treated with 2 drops of water, 4 drops of concentrated sulphuric acid, 3 ml. of 48% hydrofluoric acid and evaporated to dryness, crucibles kept in the muffle furnace for 5 minutes at 1000° C. cooled and weighed. The procedure is repeated till constant weight ($w2$) is obtained. The loss in the weight ($w1 - w2$) gives the weight of the silica. The residues left in crucibles are due to the oxides of Al, Fe, Ti, etc. Blanks were run through concurrently and the results corrected. The results of analyses are presented in Table I.

Silica can be present in water in ionic and in colloidal form. The plant takes up silica from solution through the roots. It is to be observed that SiO_2 accumulated more in the kernel than in the water. The differences in silica content from different region can be attributed to the environmental conditions of growth of the coconut fruits. The tender coconut contains less silica than the matured ones. The presence of silica in fruits, crops, etc. has been reported[3] earlier also but the biological significances of silica in them is not clearly understood. High soluble silica content in well water, collected from Kerala have been reported by others,[4] and in the present work higher soluble silica as seen in well waters from a region seem to indicate higher silica content in the coconut collected therefrom. It

TABLE I

Analysis of Coconut kernel and water for silica

| | Wet coconut kernel (bare) | | | Coconut water | | | |
	Wt. ash	Total loss in wt. during HF treatment i.e., SiO_2 ($w1 - w2$)	Silica μgm /gm	Volume (ml.)	Total loss in wt. during HF treatment, i.e., SiO_2 (gm.) ($w1 - w2$)	Silica μgm/ ml.	Well water content
... ...	0.520	0.0870	327.3	900	0.1104	122.7	..
...	..	..	..	3750	0.4800	128.0	..
... ...	1.24	0.0722	158.3	900	0.0420	46.7	..
... ...	.023	0.0124	408.6	1550	0.0712	46.0	14.3
... ...	1.04	0.7124	455.5	1450	0.1012	69.8	24.8
... ...	1.45	0.6303	132.3	1400	0.1096	78.3	24.0
... ...	..	..	..	4500	0.0090	2.0	8.0
... ...	..	..	..	3500	0.1030	29.4	..

is possible that silica content· in coconut samples collected from Kerala may be associated with the available soluble silica in soil.

The author is thankful to Dr. A. K. Ganguly, Head, Health Physics Division, for his encouragement and guidance in the course of the work.

Health Physics Division,   T. N. V. PILLAI.
Bhabha Atomic Research
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COMPONENT FATTY ACIDS OF THE SEED OIL OF *BOSWELLIA SERRATA* (ROXB.)

Boswellia serrata, the Indian Olibanum (Marathi : *Kundur*, Hindi : *Salai*) is a moderate sized gregarious tree belonging to the family *Burseraceæ*. It is distributed in the tropical parts of Asia and Africa. The gum is used in rheumatism, nervous diseases and urinary disorders.[1] The flowers and the nuts are eaten by the Bhils. Work has been reported on the chemical examination of its gum oleo-resin and wood,[2-4] and the present study concerns the fatty oil from the seeds.

Fruits were collected from the trees on hilly areas in Nagpur and the seeds were powdered without separating the testa, and extracted exhaustively with petroleum ether (B.P. 40-60°). The extract was filtered and the solvent removed under reduced pressure to leave behind a yellow oil (8·7%) which had the following characteristics : Refractive index (η_D^{35}) 1·4682 ; F.F.A. 4 ; Iod. N. 116 ; Sap. value 195 ; unsaponifiable matter, 2·1%. Oil was saponified and the fatty acids obtained were converted to methyl esters.

The methyl esters were dissolved in a small amount of chloroform and immediately injected into a Gas-Liquid Chromatographic apparatus, an F and M Model 720 dual column temperature programmed unit, provided with thermal conductivity detector. The conditions of operation were as follows : column, 8 ft. × 3/10 inch (OD) in stainless steel ; packing, 20% DEGS on chromosorb W· (mesh 45-60) ; carrier gas, hydrogen with flow rate 50 ml./minute ; injection port temperature, 300° ; detector block temperature, 290° ; column temperature, 220° ; current, 150 ma ; attenuaton 4 ; chart speed, 30 in./hour; Hamilton 10 μl. capacity syringe was used for injection of the samples. 3 μl. of the methyl ester sample in chloroform was injected. Comparison of the retention times of unknown compound with authentic samples were used for confirming the peaks. Quantitative determinations were made by calculating the area under each peak by triangulation. The results given are percentages of the sum of the areas of all the peaks as well as the molar percentages (Table I).

TABLE I
Gas-liquid chromatographic results of the analysis of the esterified fatty acids

Peak No.	Fatty Acid Ester	Methyl Ester %	Molar %
1	Palmitate	14·2	15·3
2	Stearate	9·7	9·5
3	Oleate	13·7	13·3
4	Linoleate	62·4	62·0

Methyl esters analysed by GLC contain palmitic, stearic, oleic and linoleic acids. It appears that this species though it contains the same acids as others of the same family[5-7] shows more of linoleic and less of oleic acids.

The authors wish to express their sincere thanks to Dr. K. T. Acchaya, Dr. Subbaram, Regional Research Laboratory, Hyderabad, and to Mr. P. B. Devdhar, Department of Pharmacy, Nagpur University, for GLC analysis.

Department of Chemical   H. A. BHAKARE.
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Laxminarayan Institute of
   Technology,
Nagpur University,
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THE EFFECT OF LACTATE ON BILE SECRETION OF ANAESTHETIZED DOGS

In contradiction to the reports of earlier workers[1] [2] that adrenaline reduces bile secretion[4] we have observed that it first increases and then decreases the rate of hepatic bile secretion. Lundholm[3] has recently suggested that the inhibitory action of adrenaline on smooth muscles is due to the lactic acid which is formed by glycogenolysis after the administration of adrenaline. It is well known that adrenaline increases the glycolysis in liver. Sahyum and Webster[6] have reported that liver glycogen is first decreased and then increased after the administration of adrenaline. Kato and Kinura[7] have shown that adrenaline increases hepatic vein blood lactic acid concentration more than

more bile samples were collected at the same intervals. Since the hypertonic solutions have been shown to reduce bile secretion[9] the isotonic solution of sodium lactate (1·85% w./v.) was employed for infusion. Similar experiments were performed on three dogs with the exception that no infusion was given. This served as control. All the bile samples collected were analysed for bile acids,[10] bilirubin[11] and cholesterol.[12]

The results are summarised in Table I. In control experiment no significant alteration in the rate of bile secretion was observed; however, the concentration of bile acid in bile, progressively declined over a period of two hours. The concentration of cholesterol in bile decreased only slightly while that of bilirubin remained unaltered.

TABLE I

Effect of lactate on the excretion of bile and its constituents

Time in min.	Rate of bile secretion mg. min./kg.			Total bile acid excretion in mg./15 min.			Total cholesterol excretion in mg./15 min.			Total bilirubin excretion in mg./15 min.		
	C	LF	LP	C	LF	LP	C	LF	LP	C	LF	LP
15	5·2	5·50	3·80	11·99	10·43	10·0	0·59	0·77	0·72	1·07	1·00	1·08
30	5·16	4·85	3·66	11·23	10·82	10·5	0·58	0·68	0·77	1·05	1·37	1·33
45	5·06	5·85	4·08	9·08	11·34	11·6	0·53	0·99	0·81	1·04	2·27	1·85
60	5·13	6·10	4·06	9·06	10·16	11·6	0·54	1·09	0·81	1·02	2·51	2·08
75	5·16	6·25	4·53	9·14	9·66	12·7	0·54	1·14	1·08	1·00	2·17	2·58
90	5·60	6·45	3·86	9·20	8·82	10·8	0·59	1·29	1·03	1·09	2·24	2·64
105	5·60	5·80	3·20	9·23	7·61	9·0	0·54	1·02	0·63	1·09	1·94	1·82
120	5·63	5·75	3·30	7·73	6·59	9·2	0·49	0·83	0·65	1·02	1·95	1·65
135	5·65	5·20	3·43	6·88	7·17	9·0	0·49	0·72	0·68	1·10	1·89	1·28

C = Control ; LF = Lactate infusion through femoral vein ; LP = Lactate infusion through portal vein ; ↓ Infusion start ; ↑ = Infusion stop.

that of peripheral or portal blood. The present work was undertaken to investigate the possibility of this lactic acid playing any role in the hepatic secretory response to adrenaline.

Healthy adult dogs of either sex (8–10 kg.) were used for the study, the procedure for collection of bile was described by Ramprasad and Sirsi.[8] After cannulating the bile duct the bile was allowed to flow for about thirty minutes since within this period the rates of bile flow become steady. Then two control samples of bile were collected at 15 minute interval and the infusion of lactate (6 to 7 mg./min./kg.) was started through the femoral vein in one set of five dogs and through the portal vein in another set of five dogs. Infusion was continued for one hour and four bile samples were collected at 15 minute intervals during the infusion. After discontinuing the infusion four

The infusion of lactate through the femoral or portal vein resulted in the increased rate of bile secretion. The analysis of bile (collected before, during and after infusion) shows that excretion of bile acids, cholesterol and bilirubin gradually increased during the period of infusion as compared to the control. These effects were more marked when the infusion was given through the portal vein. After discontinuing the infusion these changes gradually returned to normal.

In the control experiment the excretions of cholesterol and bile acid were reduced by about 8·4 and 23·8% respectively at the end of one hour. In the dogs receiving the lactate infusion through femoral vein the excretion of bile acid was reduced only by 8·5% while that of cholesterol and bilirubin was increased by 48 and 110% respectively at the end of the same

period. In dogs receiving the lactate infusion through the portal vein the excretion of bile acid, cholesterol and bilirubin increased by 27, 40 and 138% respectively at the end of same period.

The intravenous infusion of lactate results in the increased rate of secretion of bile and excretion of bile acid, cholesterol and bilirubin showing thereby that the hepatic secretory response to lactate is an augmentory one. This response is more pronounced if the lactate infusion is given through the portal vein suggesting that the factors involved in such response are intrahepatic. Schwiegh[13] has reported that lactate augments the hepatic circulation which is in agreement with the report that lactate is a powerful vasodilator.[14] Increased circulation through the liver results in the increased bile secretion. It is therefore probable that the augmentory hepatic secretory response to lactate is due to the increased circulation through liver. The increase in the excretion of bile constituents namely bile acids, bilirubin and cholesterol during lactate infusion shows the increased hepatic cellular activity.

Adrenaline causes increased glycolysis in the liver which results in the increased lactic acid level in the hepatic blood.[7] Increased intrahepatic circulation has also been reported to follow the adrenaline injection.[15] It is possible that this hemodynamic response of liver is related to the metabolic response to adrenaline.

In summary, the effect of the infusion of isotonic solution of sodium lactate through femoral and portal vein on the rate of secretion and composition of bile has been studied in anæsthetized dogs. The infusion of lactate through femoral or portal vein results in increase in the rate of the secretion with concomitant increase in the excretion of bilirubin, cholesterol and bile acids through it. These changes were more marked when infusion was given through the portal vein.

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Nagpur University,   A. K. DORLE.
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A NOTE ON THE STRATIGRAPHY AND MICROFAUNA OF THE KIRTHAR BEDS OF THE JAISALMER AREA

THE presence of Kirthar beds from Rajasthan was first noted by Singh.[1] He recorded its occurrence from a locality near Kolayat in Bikaner area and extended the paleogeographical coastline of the Kirthar sea (previously limited only to western extremity of western India, Singh[2]) further east to near Bikaner. Subsequently Chatterji[3] reported the occurrence of another outcrop of the Kirthars from the Jaisalmer District and thus further extended the Kirthar coastline up to Jaisalmer, southwest of Bikaner. Chatterji[3] (op. cit.) recognised two distinct horizons of the Eocene beds in the Jaisalmer area—one containing *Nummulites atacicus* Leymerie and *Assilina granulosa* (d'Archiac) of Laki age and the other, an upper one, containing *Dictyoconoides cooki* (Carter) *Alveolina oblonga* d' Orbigny along with *Nummulites atacicus* and *Assilina granulosa* of Lower Kirthar age. The exact locality at which the Kirthar beds occur was, however, not given by Chatterji.

Recently Mathur and Evans[4] have given a complete stratigraphical succession along with a geological map of the Jaisalmer District. They assign the beds exposed at Bandah to Kirthars and the beds at Khuiala (a locality five miles south-east of Bandah) to Lakis.

The object of this short note is to give in brief the little-known stratigraphy and the important microfauna of the Kirthar beds exposed at Bandah (70° 21′ E : 27° 11′ N.), district Jaisalmer. The stratigraphical succession as exposed at Bandah is given below. The Kirthar beds are divisible into four units on the basis of their contained fauna and lithology.

Stratigraphical succession exposed at bandah

Age	Units	Lithology and fauna
Post Kirthar		Greyish white grits overlain by laterite and lime kankers unfossiliferous.
		.... Unconformity ....
	4	Whitish limestone containing abundant *Discocylina hsfirus* (Sowerby) and *Discocylina* sp. (Cutter), *Assilina dilipta* (Sowerby) var. *Assilina* Salve tai, *Lhatta* sp. in lime and echinoids. Thickness 4'
Middle Kirthars (Lutetian)	3	Ferruginous sandy limestone in the lower horizons and white coloured limestone in the upper horizons containing abundant *Discocylina sder* (d'Archiac) *Discocylina* sp. other Nuttal *Nummulites atacicus* Nuttal, *Nummulites* sp., *Operculina* spp. *Operculina* spp. molluscs and echinoids. Thickness 6
	2	Brownish calcareous sandstone containing abundant *Ostrea* sp. and *Nummulites obesus* var. Thickness 3'
	1	Reddish brown sandstone containing *Discocylina* in the upper horizon. Thickness 5
		.... Unconformity ....
Laki		Shaly limestone associated with full of earth, containing *Assilina* sp. and *Davies* in the top horizons and *Assilina granulosa* (d'Archiac), *Assilina daviesi* the Crescent *Nummulites atacicus* Leymerie. Thickness not known

Detailed work on the microforams from these beds is in hand and will be published elsewhere. The author is deeply indebted to Dr. S. B. Bhatia, Panjab University, for his guidance. Grateful thanks are also due to Prof. R. S. Mithal, University of Roorkee, for kindly providing laboratory facilities.

Dept. of Geology and   S. C. Khosla
  Geophysics,
University of Roorkee,
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ANKARAMITE FLOWS AND DYKES OF ASNAVI AREA—WEST RAJPIPLA HILLS, GUJARAT STATE

TILL recently the Deccan Trap basalts were being considered to be uniformly tholeiitic in nature and any variants noticed aroused interest among petrologists in search of differentiates of basalts. The author during his research work on the post-trappean alkalic complex in the Rajpipla area, noticed four different flows of traps exposed in the hills east of Asnavi (Long.: 73° 19'; Lat. 21° 41'). Prominent phenocrysts of pyroxenes and minor phlogopite appear in the younger two flows and the plagioclases decrease in amount from the oldest to the youngest flows, so that they are practically absent or confined to the groundmass in the ankaramites exposed at the top of the hills. Blandford (1869) and Bose (1884) had mentioned the presence of porphyritic basalts from this area but beyond this no detailed petrographic account seems to have been recorded in available geological literature.

The rock types described here are found in a group of hills around Asnavi and Kakaria toposheet No. 46 G/6, between Netrang and Rajpardi. The ankaramite flow occurs at an altitude of 650 feet. On the basis of field and petrographic evidence, three different flows underlying the ankaramite, have been distinguished. Several dykes of ankaramite, about 10 feet in thickness and trending northwesterly, could have acted as feeders to these flows. The flows detailed here occupy an area of about one square mile, now discontinuous, dissected by intervening valleys.

Description of Rock Types. The four different flows were distinguished on the basis of (*a*) their vesicularity and amygdaloidal nature, (*b*) the amount and development of phenocrysts of individual minerals and (*c*) variations in percentages of pyroxenes and plagioclases with minor amounts of olivine and phlogopite.

The main variation in the four flows is confined to the proportions of plagioclase and pyroxene, chiefly in the phenocrysts. The youngest of the four flows is of ankaramite and its petrographic details need detailed account.

The ankaramites are melanocratic, heavy (sp. gr. 3.1) and show porphyritic texture with prominent phenocrysts (5 mm. in the flows and 1 to 1.5 cm. in the dykes) of pyroxenes. These are greenish to bottle green in colour. The flows are vesicular. The matrix is dense black, both in the flows and dykes.

Though there is an apparent similarity megascopically, the difference between these is manifested under the microscope, which mainly lies in the nature of the pyroxenes and crystallinity.

Ankaramite Flow. The flow consists chiefly of euhedral, phenocrystal pyroxenes. Groundmass pyroxenes are too small to be studied. Pyroxenes are colorless, non-pleochroic and

feebly zoned. Occasional twinning (on 100 plane) is seen. They show corroded margins as also release of iron ore. $Z \wedge C$ is 44°; optic axial plane $||$ (010); the optic axial angle of the pyroxenes, using 4-axis universal stage, was found to vary from 30° to 48°; majority of them lying in the 40°–48° range. The refractive indices of the pyroxenes were determined following the method of Hess (1949)

$$X = 1 \cdot 693 \qquad Z - X = \cdot 027$$
$$Y = 1 \cdot 698 \qquad Y - X = \cdot 005$$
$$Z = 1 \cdot 720$$

Thus from the nature of the 2V and the refractive indices the pyroxenes belong to the groups of sub-calcic augites and augites. A few grains of olivine, altered to iddingstite, are found; and iron ores are distributed uniformly. Texture is porphyritic; pyroxene phenocrysts showing glomeroporphyritic habit. The groundmass is cryptocrystalline.

The mode of the rock is as follows:

Pyroxenes	.. 31·2%
Olivine	.. 0·04%
Groundmass	.. 68·76%

Ankaramite Dyke.—Here the pyroxene phenocrysts have developed to a larger size, compared to the flows, and micro-phenocrysts of plagioclase are seen in the groundmass. Pyroxenes are strongly zoned, and orthopinacoidal twinning is common. Also pyroxenes showing low axial angles (10°) have been met with, which are absent in the flows.

F. J. Turner's (1942) method was used for the pyroxenes which indicated a low 2V. Out of the fifty grains studied, about ten gave axial angles less than 10°, one 15°, and the rest in the range 40°–44°. The optic axial plane of the pyroxenes with low 2V, was found to be $\perp$ (010) whereas for those with moderate 2V it was $||$ (010). The 2V decreases from the core to the margin in the zoned crystals. The Y refractive index for a pyroxene with a moderate 2V was found to be 1·705 (Hess's method). $Z \wedge C$ is 39° for pigeonites and 44° for sub-calcic augites.

Thus both pigeonites and sub-calcic augites are present here. The composition of the microphenocrysts of the plagioclase felspars using the U-Stage [measuring extinction angle in the zone (010)] was found to be An 55; olivine is altered to yellowish green iddingsite; a few flakes of phlogopite are present. Iron ore is peppered throughout the rock.

Texture is porphyritic, pyroxenes show prominent glomeroporphyritic habit and poikilitically enclose grains of iron ore. Microphenocrysts of plagioclase occur in the cryptocrystalline groundmass.

The modal analysis of the rock is as follows.

Phenocrysts :	Pyroxenes	..	42%
	Olivine	..	1·1%
	Phlogopite	..	3·7%
Groundmass :	Plagioclase	..	7·0%
	Iron ore	..	9·1%
	Rest	..	37·1%

Conclusions.—On account of the abundance of pyroxenes, the rock is classified as ankaramite. Pigeonites here are confined to the dykes and pyroxenes with moderate 2V are dominant in the flows.

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Centre of Advanced   P. KRISHNAMURTHY.
    Study in Geology,
University of Saugar,
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THE MORPHOLOGY OF *TRICHOMITUS BATRACHORUM* (PERTY, 1852) HONIGBERG, 1963 FROM TWO SQUAMATE REPTILES, *ERYX JOHNI* AND *VARANUS SP.*

Trichomitus batrachorum (Perty, 1852) Honigberg, 1963 is a common inhabitant of the rectum of numerous species of Amphibians and reptiles. Honigberg (1953)[1] gave a comprehensive account of its structure, synonymy and host list, under the name *Tritrichomonas batrachorum*. The same author in 1963[2] distinguished the 'batrachorum' type from the augusta' type of trichomonads and placed the

former in the genus *Trichomitus* Swezy, 1915. During the course of a survey of the intestinal flagellates of reptiles of the Hyderabad region, two squamate reptiles, *Eryx johni* and *Varanus* sp., were found to harbour trichomonads, which were almost similar to those described by Honigberg, 1953. As far as could be ascertained from the literature, this is the first record of this species from these hosts.

The parasite is variable in shape, being spherical (Figs. 3, 4, 10), ovoidal (Figs. 1, 3, 6, 9) or pyriform (Figs. 7, 12-15). The anterior half of the body is broad and rounded, while the posterior half is narrow and tapering (Figs. 14, 15).
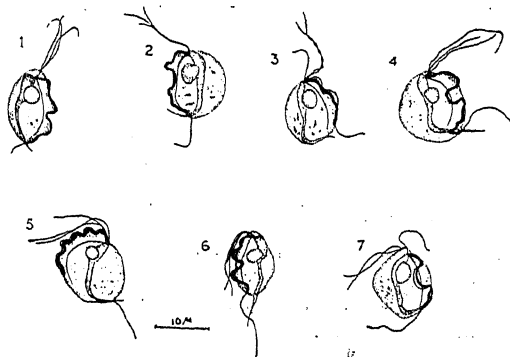
The blepharoplast is a large and conspicuous granule, situated very near the anterior end of the body. It is the seat of origin of the various mastigont elements (Figs. 1-4, 8, 10-12). The three anterior flagella are unequal (Figs. 1-4, 11-15) and measure, on the average, $11 \cdot 25 \mu$, $14 \cdot 40 \mu$ and $16 \cdot 30 \mu$ in the strain from *Eryx* and $11 \cdot 26 \mu$, $15 \cdot 32 \mu$ and $18 \cdot 22 \mu$ in the strain from *Varanus*. Usually, the shortest is separated from the other two, which run together for some distance (Figs. 3, 7). The posterior flagellum runs along the outer border of the undulating membrane and becomes free posteriorly. The free portions measure $10 \cdot 32 \mu$ and $10 \cdot 39 \mu$ on the average, in the two strains from *Eryx* and *Varanus* respectively. The accessory filament is slightly thicker and runs along the border of the membrane of its entire length (Figs. 3, 5, 7, 11). The undulating membrane extends almost upto the posterior end of the body and is thrown into three to five folds (Figs. 4-6, 12-15).

The costa is thin and thread-like and runs below the base of the undulating membrane for its whole length. It is as thick as the flagella, but becomes thinner and tapering as it curves downwards (Figs. 5, 7, 13). There are a row of paracostal granules along the outer border of the costa (Figs. 8-10).
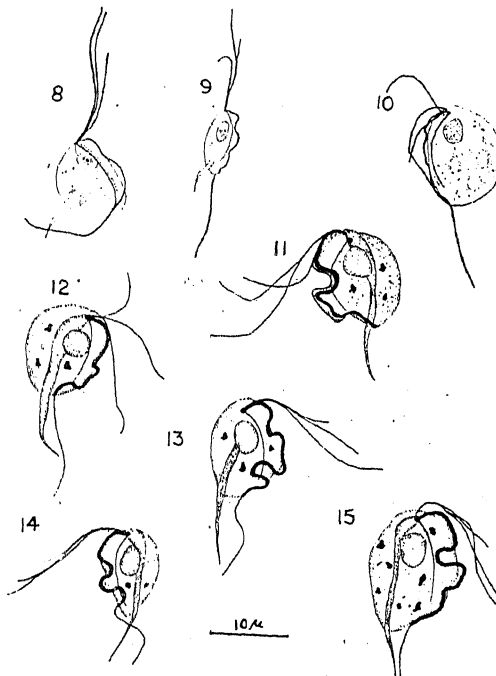
The axostyle is well developed and has a spoon-shaped capitulum, which is about 2μ wide (Figs. 1, 2, 5, 11, 14). The rest of the axostyle gradually narrows down and finally projects out of the body at the posterior end (Figs. 1, 4, 8, 9, 13-15), the free spike-like part is very conspicuous and measures about $\cdot 67 \mu$ and $5 \cdot 39 \mu$ in the two strains. There are 10 periaxostylar chromatic rings.

The nucleus, situated on the lateral side of the capitulum (Figs. 1, 5, 11), is oval or spheri-

cal and measures, on the average, $2 \cdot 28 \times 2 \cdot 57 \mu$ and $3 \cdot 18 \times 2 \cdot 47 \mu$ in the strains from *Eryx* and *Varanus* respectively. There is a small eccentric endosome, surrounded by a few scattered chromatin granules (Fig. 8). A well-developed rhizoplast runs forward from the nuclear membrane to the blepahroplast.

FIGS. 1-7. Parasites from *Eryx johni*, from materila fixed in methanol and stained with Giemsa.

FIGS. 8-15. Fig. 8-10: Parasites from *Eryx johni* from material fixed in Schaudinn's fluid and stained with Heidenhain's Iron Hæmatoxylin. Figs. 11-15. Parasites from *Varanus*, from material fixed in methanol and stained with Giemsa.

The pelta as well as the cytostome are absent.

The dimensions of the parasite from the two hosts show the following range :

S. No.	Particulars	Strain from *Eryx*	Strain from *Varanus*
1	Length of the body ..	8·74–16·45 μ (12·22)	8·23–17·99 μ (12·11)
2	Breadth of the body	5·14–11·82 μ (8·47)	4·11–15·42 μ (8·33)

The organisms described herein agree with the description of Honigberg, except for the absence of the pelta and minor variations in the body dimensions.

I am grateful to Dr. S. S. Qadri for his help and guidance and to Dr. S. N. Singh and Dr. S. Mehdi Ali for providing me the facilities and for their keen interest in this work.

Department of Zoology,   R. KRISHNAMURTHY.
Marathwada University,
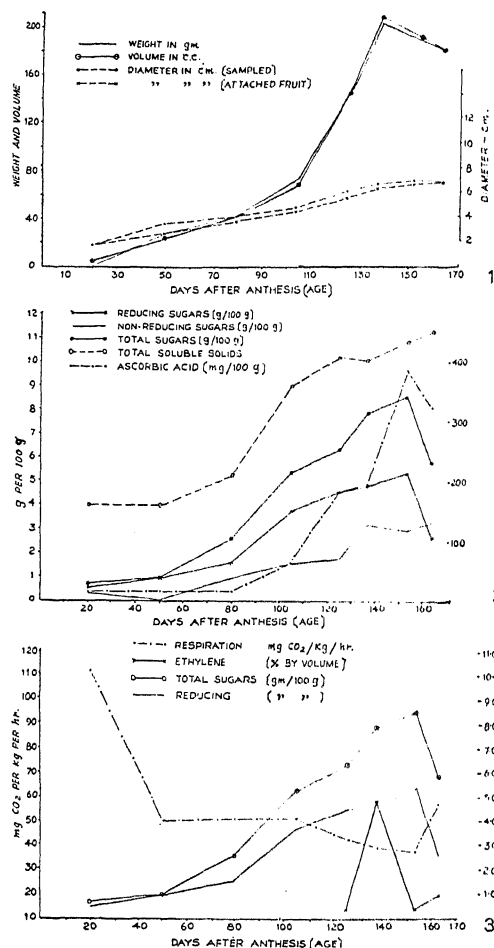Aurangabad (Maharashtra).
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PHYSICO-CHEMICAL CHANGES IN INDIAN GUAVAS (*PSIDIUM GUJAVA* L.) DURING FRUIT DEVELOPMENT

STUDIES on growth and physico-chemical changes during fruit development of three Indian varieties of guava (*Psidium gujava* L.), an important tropical fruit, reveals that the growth curve was of the sigmoid type, and the fruits took about 137 days in Safeda (Fig. 1), 110 days in R.F. Pyriform and 106–138 days in Lucknow 49 to reach maturity. The ascorbic acid content increased continuously till harvest registering 243 mg., 365 mg. and 388 mg. per 100 gm. flesh in R.F. Pyriform, L 49 and Safeda respectively. These figures are lower than 1114 mg. registered in Frank Malharbe variety in South Africa reported by La Riche.[1] The changes in reducing, non-reducing, total sugars and TSS in Safeda are shown in Fig. 2. Other varieties show similar trend. The total pectin content (AUA) was found to be on the decline after it reached the maximum in 100–110 days from anthesis ; the highest (0·440 gm./100 gm.) being recorded in Safeda 80 days after anthesis. A point of special interest is that presence of starch could not be detected at any stage, confirming the earlier findings of La Riche.[2]

The changes in respiration, total and reducing sugar and ethylene production are shown in Fig. 3. At harvest time, there was a rise in respiration rate, which may be compared with climacteric rise in mango, apple and other fruits. Ethylene was detected in appreciable quantity, 137 days after anthesis in Safeda (4·98% by volume), and 110 days after anthesis in RF Pyriform (6·83%), coinciding with the stage when the fruits started colour change.

FIGS. 1–3.   Fig. 1. Growth of fruits in safeda   Fig. 2. Changes in total sugars, reducing sugars, non-reducing sugars, total soluble solids and ascorbic acid in safeda. Fig. 3. Respiration rate and its relation with total sugars, reducing sugars and ethylene in safeda.

On the basis of the present studies, the maturity standard for Safeda may be fixed at TSS 11, Magness Pressure Test of 6·7–12·6 lbs., colour light to straw yellow (half ripe) and total sugar/acid ratio of 20·5–29·25.

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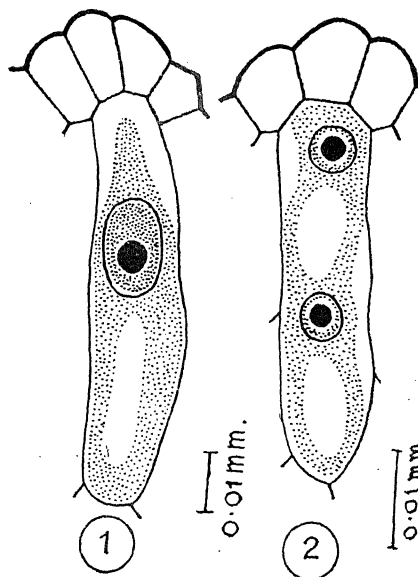2. —, *Union S. Afr. Dept. Agric.*, *Sci. Bull.*, 1951, **226**.

DIPLOSPORY IN AN INTERSPECIFIC HYBRID OF RICE, AS EVIDENCED FROM ITS EMBRYOLOGY AND EMBRYO-CULTURE STUDIES

INTERSPECIFIC hybridization in plants besides offering a means to determine the relationship and the origin of different species in a genus, is also helpful in producing chromosomal variants that may lead to the evolution of new types of high economic value. The interspecific hybrids are generally sterile and the sterility may be complete or partial and controlled by genetic system. In the expression of sterility, in addition to gametogenesis the functioning of embryo-sac and physiological checks on embryo development are important. A completely sterile hybrid between *Oryza sativa* and *Oryza officinalis* was selected and studied to pin-point the cause(s) of sterility.[1]

As is typical of the genus and parent, ovary is superior, monocarpellary, unilocular with a single anatropous ovule. The latter is bitegmic and tenuinucellate. The micropyle is formed by the inner integument alone and vascular trace to the ovule terminates near the chalaza. The female gametophyte follows a typical *Polygonum* type of development[2] except that antipodals divide and produce an antipodal tissue. However, the development to the formation of normal embryo-sac is very rare mainly due to non-homology of chromosomes.

In analysing the percentage of normal embryo-sacs, 162 flowers were fixed just before anthesis and they were sectioned. It was found that about 6% of the ovules alone showed full development of female gametophyte and among these 2·4% of the embryo-sacs were about one and a half times bigger in size. While studying earlier stages of development, it was observed that some of the megaspore mother cells were of bigger size and these without undergoing reduction division, functioned directly to produce unreduced embryo-sac (Figs. 1 and 2), perhaps as a result of restitution nucleus. The unreduced nature of the embryo-sacs is confirmed on their bigger size

as also from the fact that there is no tetrad formation, with the result that three degenerating megaspores which otherwise remain as dark patches capping the embryo-sac even upto two-nucleate stage, could not be traced in the nucellus.

FIGS. 1-2. Fig. 1. Unreduced megaspore. Fig. 2. Unreduced two-nucleate embryo-sac.

In the year 1960, two spikelets on this plant showed part-developed ovaries. They were kept under observation and when no further growth in them was noted, they were excised for embryos and the latter were cultured on nutrient agar[3] under aseptic conditions. The plants thus raised resembled F_1 cytogenetically (Fig. 3),
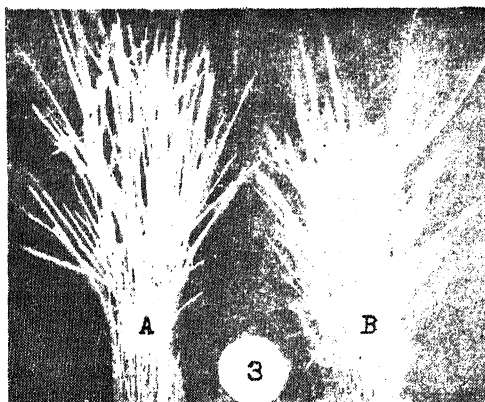

FIG. 3. A. F_1 hybrid and B. full-grown apomict.

supporting embryological observations that the 'seed' cultured had developed as a result of diploid parthenogenesis.

Earlier studies on this hybrid by Ramanujam[4] show that when the F_1 was back-crossed to *O. sativa* parent the resulting progeny turned out to be sterile allo-triploid, thereby showing that female gamete is $n = 24$, *i.e.*, diploid.

Further evidence of this hybrid producing unreduced female gametes is presented by Srinivasan *et al.*[5] when they crossed it with the pollen of a tetraploid rice, *O. eichengeri* syn. *O. schwenfurthiana* and secured a tetraploid tri-specific hybrid.

It can thus be concluded that though apparently 6% ovules show normal embryo-sacs, only 2·4% (which are unreduced) are functional, since no diploid plant has so far been obtained when crossed with pollen from a diploid rice variety.

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Maharashtra Association for A. B. SAPRE.
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INDUCTION OF MALE STERILITY IN *ALLIUM CEPA* L.

BICHPURI local red variety of onion was treated with aqueous solutions of mendok (FW-450) and MH (maleic hydrazide). The bulbs were planted at distances of 20 cm. in single-row plots, each 3 m. long. Alternate rows to treated plants were left untreated to allow a sufficient supply of pollen for cross-pollination. Concentrations of mendok employed were 0·01, 0·025, 0·05, 0·1 and 0·2% and those of MH were 0·001, 0·005, 0·01, 0·025 and 0·05%. Treatments were made by injecting equal amounts of solutions into the base of the infloresence bearing stalk at a time when inflorescence was noted to come out as a small protuberance. The extent of induced pollen sterility was checked on every fifth day using 0·5% acetocarmine. The average of three plants was taken as the pollen sterility percentage of that treatment. In order to estimate the extent of ovular damage, three inflorescences from each plot were bagged (selfed), three were left for open pollination and three others were bagged and then hand-pollinated daily for eight to twelve days.

Effect of the two chemicals on the general growth of plants was not marked and no evidence of phytotoxicity was noted in any treatment. Flowers from the plants receiving injections of mendok and of MH upto 0·005% were almost normal in size and appearance. However, as the concentration of MH increased beyond this level, the flower size was reduced. The reduction in flower size was found to be proportional to the increase in the concentration of MH. Flower size, following application of MH, has also been reported to reduce in dayflower,[1] *Cajanus cajan* (L.) Millsp.[2] and *Trigonella fœnumgrœcum* L.[3] The reduction in flower size was not accompanied by the closing of flowers. Hence there was no barrier to natural crossing.

Flowers from 0·025% MH treated plants possessed yellowish perianth lobes as compared to the white of untreated flowers. Also the anthers from treated plants were smaller, rounded and white with shorter filaments as against dark brown to black, elongated anthers with relatively large filaments of control (Fig. 1). The anthers of the treated plants were invariably indehiscent.

FIG. 1. Flowers from untreated (*a*) and HM treated (*b*) plants. Note the difference in size and shape of the anthers.

The extent of pollen-sterility induced in each treatment is presented in Table I, an inspection of which reveals that none of the treatments with mendok could cause complete pollen sterility. But the concentrations of MH at and above 0·01% were quite effective in causing 100% pollen sterility. This is well in accord with that reported earlier for onions.[4] Even

the last flowers to bloom in treated heads were found to be completely male sterile.

Pollen abortion was not the only way in which sterility was induced. Frequently in 0·025% and mostly in 0·05% MH-treated plants, the anthers were found to be practically devoid of any contents or on squashing yielded only a mass of degenerated tissue. Apparently in such anthers the chemical actually interfered with pollen formation rather than causing abortion after the pollens were formed. Possibly this is a result of premature abortion of pollen mother cells or even sporogenous tissue.

TABLE I

Effects of different concentrations of chemicals on Pollen sterility* and fruit-set percentage†

Chemical	Con-centra-tion (%)	Pollen sterility (%)	Fruit-set (%)		
			Selfing	Open pollina-tion	Hand pollina-tion‡
Mendok ..	0·010	9·08	96·30	95·60	96·60
,, ..	0·025	6·00	90·00	97·00	94·00
,, ..	0·050	10·60	92·00	94·00	97·00
,, ..	0·100	14·00	81·00	90·00	91·50
,, ..	0·200	30·90	72·00	86·00	92·00
MH ..	0·001	46·00	86·60	78·60	86·30
,, ..	0·005	81·62	40·80	80·40	76·00
,, ..	0·010	100·00	00·00	69·00	81·00
, ..	0·025	100·00	00·00	46·00	62·00
,, ..	0·050	100·00	00·00	9·00	11·00

* Pollen sterility in untreated plants was 8%.
† Number of fruits in untreated plants has been assumed to be 100%.

Results of selfing and crossing tests of plants from treated plots are summarized in Table I. A perusal of Table I reveals that all MH treatments resulted in a reduction of the number of fruits borne on pollinating the treated heads with the pollen from untreated plants. Furthermore, the number of fruits followed an inverse relationship with the increase in the concentration. The highest percentage of fruits on hand-pollination was obtained in 0·01% treatment. Also on selfing, this treatment yielded no fruits, which was quite expected for all the flowers were completely male sterile.

Of the various treatments of MH capable of causing complete pollen sterility, maximum fruit-set under both open and hand-pollinated conditions was obtained in 0·01% concentraction. There appears a promise for increasing the fruit-set and cosequently yield through a careful manipulation of the dosage of the chemical.

Department of Botany,   C. L. KAUL.
R.B.S. College,   S. P. SINGH.
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ADDITIONAL NEMATOPHAGOUS FUNGI FROM DELHI SOILS

NEMATODES in soil have many natural enemies and the nematophagous fungi are one of the most important of these. A number of these fungi have been studied and reported, both as regards their systematic position as well as their possible use in controlling plant parasitic nematodes.[2-6,8] However, there are only two reports of nematophagous fungi from Indian soils.[1,7] During the course of investigations on soil fungi at Delhi, three fungi, hitherto unrecorded from India, were encountered parasitising nematodes. The diagnostic characters of these fungi are reported here.

1. *Stylopage hadra* Drechs. 1935 in *Mycologia,* 27, 209.

Mycelium sparingly branched, continuous. Hyphæ hyaline, usually about 2·3–3·4 μ wide; forming yellow, orbicular protuberances upto 10–15 μ in diameter and holding the nematodes by means of these protuberances and perforating their integument resulting in production of hyphæ inside their bodies. Conidiophores 220–340 μ, in length and tapering to about 2–2·5 μ at the apex bearing a single apical conidium. Conidia hyaline, obovoid, 23·2–34·4 μ by 6·9–11·6 μ. Nematodes belonging to the genera *Rhabditis* and *Cephalobus* were observed to be parasitised by these fungi (Fig. 1, 1-2).

2. *Stylopage grandis* Duddington, 1955 in *Mycologia,* 47, 245.

Vegetative hypha sparse, and hyaline. Observed to be capturing the nematodes (mostly of the genera *Rhabditis* and *Cephalobus*) by means of adhesive secretion. The body of the nematode is penetrated by hyphæ which grow out from the point of attachment and these trophic hyphæ eventually fill the carcas of the victim. The trophic hyphæ are 2·0–2·4 μ wide. Conidiophore are erect, 300–350 μ long, bearing,

FIG. 1 (1-3). 1 and 2. *Stylopage hadra.* 1. Orbicular protuberance of hypha capturing nematode.
2. Nematodes captured by mycelium. Arrow shows spores of the fungus. 3. *Dactylaria brochopaga* show-
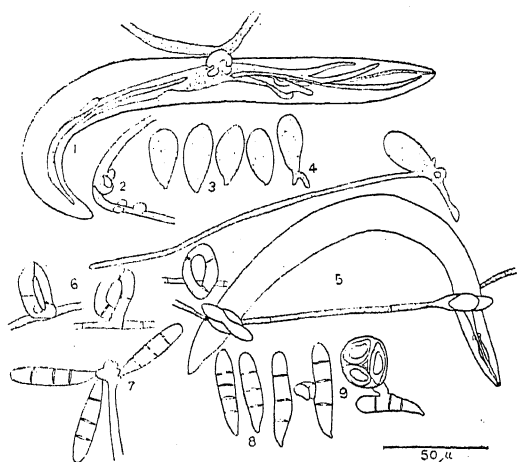ing constricted ring formation on mycelium.

FIG. 2 (1-9). 1-4. *Stylopage grandis.* 1. Nematode captured by adhesive secretion of the hypha. Trophic hypha inside the nematode body. 2. Secretion of adhesive material on the hypha. 3. Conidia. 4. Germinating conidia. 5-9. *Dactylaria brochopaga.* 5. Nematode captured by constricted rings. 6. Structure of constricted ring. 7. Conidiophore and conidia. 8. Conidia. 9. Germinating conidia and closed constricted ring.

acrogenously, a single large conidium or often producing a second conidium after elongation of the conidiophore. Conidia obovoid or pyriform measuring $32 \cdot 4 - 38 \cdot 1 \mu$ by $9 \cdot 2 - 11 \cdot 6 \mu$ (Fig. 2, 1-4).

3. *Dactylaria brochopaga* Drechs., 1937 in *Mycologia*, 29, 514.

Hyphæ hyaline, septate, $1 \cdot 5 - 2 \cdot 5 \mu$ wide and producing constricting rings at right angles to

their axis. The rings are circular in outer diameter and are composed of three acurate cells. After capturing the nematodes (*Rhabditis* and *Cephalobus*) the ring, as a result of contraction and inflation of its component cells, constricts the nematodes to death. Conidiophore hyaline, septate, erect and measuring $174-232 \mu$ and tapering gradually upwards to $1 \cdot 16 - 2 \cdot 32 \mu$. Two to fifteen conidia are borne on the short sterigmata of the conidiophores in a radiate arrangement. Conidia are hyaline, straight or slightly curved, cylindrical or elongated ellipsoidal, broadly rounded at the apex and measuring $23 \cdot 2 - 40 \cdot 6 \mu$ by $4 \cdot 6 - 5 \cdot 8 \mu$. The conidia are 3 to 4-septate (Fig. 2, 5-9 and Fig. 1, 3).

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Division of Mycology and   J. Sachchidananda.
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Indian Agricultural
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REVIEWS AND NOTICES OF BOOKS

Organic Photochemistry : A Series of Advances (Vol. 1). Edited by Orville L. Chapman. (Marcel Dekker, Inc., 95, Madison Avenue, New York), 1967. Pp. xi + 339. Price $ 15.75.

Organic photochemistry is the science arising from application of photochemical methods to organic chemistry and organic chemical methods to photochemistry. It is an interdisciplinary frontier.

Intense activity in organic photochemistry in the last decade, especially in the last five years, has produced so vast an accumulation of factual knowledge that chemists in general have viewed it with awe. Even those chemists engaged in the study of organic photochemistry find the rate of development of the field perplexing in high degree. This series has been created to fill the need for a critical summary of this vigorously expanding field with the purpose of drawing together seemingly unrelated facts, summarizing progress, and clarifying problems.

The subject matter in this volume has been dealt with under the following titles : Photochemical Transformations of Cyclohexadienones and Related Compounds, by Paul J. Kropp ; Photochemical Transformations of Small Ring Carbonyl Compounds, by Albert Padwa ; Photo Fries Reaction and Related Arrangements, by Virgil I. Stenberg ; Photochemistry of Tropanoid Compounds, by Daniel J. Pasto ; Photochemistry of Olefins, by G. J. Fonken ; The Photoreduction of Stilbenes, by F. R. Stermitz ; and Photocycloaddition Reactions, by O. L. Chapman and G. Lenz.   C. V. R.

Annual Review of Biochemistry (Vol. 36, Part I). Edited by Paul D. Boyer. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California U.S.A.), 1967. Pp. vii + 406. Price $ 11.00 in U.S.A. and $ 12.00 elsewhere.

Annual Review of Biochemistry (Vol. 36, Part II). Edited by Paul D. Boyer. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California, U.S.A.), 1967. Pp. iii + 378. Price not given.

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Annual Review of Plant Physiology (Vol. 18). Edited by Leonard Machlis. (Annual Reviews, Inc., 4139, El Camino Way, Palo Alto, California 94306, U.S.A.), 1967. Pp. viii + 480. Price $ 8.50 in U.S.A. and $ 9.00 elsewhere.

The contents of this volume are : Cell Structure and Function : Ultrastructure and Formation of Plant Cell Walls, by Kurt Mühlethaler ; The Nucleolus in Cell Metabolism, by Max Birnstiel ; Mineral Nutrition : Sulfur Metabolism in Plants, by John F. Thompson ; Nitrogen Metabolism : Aspects of Amino-Acid Metabolism in Plants, by L. Fowden ; Fixation of Nitrogen

by Higher Plants other than Legumes, by G. Bond ; Protein Synthesis in Higher Plants, by Rusty Jay Mans ; Respiration : Structure of the Mitochondrial Electron Transfer Chain, by David E. Green and Israel Silman ; General Metabolism : Alkaloid Biosynthesis, by Edward Leete ; Biosynthesis of Carotenes, by John W. Porter and David G. Anderson ; Fat Metabolism in Plants, by J. B. Mudd ; Transformation of Sugars in Plants, by W. Z. Hassid ; Absorption and Translocation : Mechanisms of Foliar Penetration of Solutions, by Wolfgang Franke ; Growth and Development : The Physiology of Phytochrome, by William S. Hillman ; Differentiation, by Heslop-Harrison ; Chemistry and Physiology of Kinetin-like Compounds, by D. S. Letham ; Mechanisms of Action of Herbicides, by Donald E. Moreland ; Stress Physiology : Freezing Stresses and Survival, by Charles Robert Olien ; Special Topics : Electric Fields in Plants, by B. I. H. Scott ; and Response to Parasites, by C. E. Yarwood.　　　C. V. R.

Advances in Food Research (Vol. 15). Edited by Chichester, Mrak and Stewart. (Academic Press, New York and London), 1967. Pp. ix + 363. Price $ 15.00.

Volume 15 of this well-known series contains the following articles : 1. Metabolic Fate in Animals of Hindered Phenolic Antioxidants in Relation to Their Safety Evaluation and Antioxidant Function, by D. E. Hatway ; 2. Radiobiological Parameters in the Irradiation of Fruits and Vegetables, by Roger J. Romani ; 3. Food Irradiation—Physiology of Fruits as Related to Feasibility of the Technology, by E. C. Maxie and Adel Abdel-Kader ; 4. Ionizing Radiation for Control of Postharvest Diseases of Fruit and Vegetables, by N. F. Sommer and R. J. Fortlage ; 5. Carotenoids : Properties, Occurrence, and Utilization in Foods, by B. Borenstein and R. H. Bunnell ; 6. Basic Principles of Microwaves and Recent Developments, by Samuel A. Goldblith ; and 7. Evaporation Methods as Applied to the Food Industry, by George D. Armerding.　　　C. V. R.

International Review of Cytology (Vol. 21). Edited by G. H. Bourne and J. F. Danielli. (Academic Press, New York and London), 1967. Pp. xvi + 384. Price $ 18.00.

Volume 21 of this well-known series contains the following articles : 1. Histochemistry of Lysosomes, by P. B. Gahan ; 2. Physiological Clocks, by R. L. Brahmachary ; 3. Ciliary Movement and Co-ordination in Ciliates, by Bela Parducz ; 4. Electromyography : Its Structural and Neural Basis, by John V. Basmajian ; 5. Cytochemical Studies with Acridine Orange and the Influence of Dye Contaminants in the Staining of Nucleic Acids, by Frederick H. Kasten ; 6. Experimental Cytology of the Shoot Apical Cells during Vegetative Growth and Flowering, by A. Nougarede ; and 7. Nature and Origin of Perisynaptic Cells of the Motor End Plate, by T. R. Shanthaveerappa and G. H. Bourne.　　　C. V. R.

Theory of Linear Active Networks. By E. S. Kuh and R. A. Rohner. (Published by Holden-Day, Inc., 500, Sansome Street, San Francisco, U.S.A.), 1967, Pp. 650. Price $ 19.25.

A special feature of this book is that the fundamental principles of active networks and their underlying *theory* receive greater emphasis in the treatment than device *modelling* or circuit *design*. Thus, despite changes that may take place from time to time in device technology, the book will continue to be of use as a foundation text-book for students of electrical engineering on active networks and their applications.

The subject-matter is treated under the following twelve chapter headings : Time Domain, Foundations of Network Theory ; Functional Characterization of Networks ; Frequency Domain Passivity Conditions for Linear, Time-Invariant n-port Networks ; Passivity, Activity, and Generativity ; Active Two-port Networks ; Scattering Matrix ; Broadband Limitations ; Theory of Broadband Matching ; Theory of Negative-resistance Amplifiers ; Theory of Linear Parametric Circuits ; Feedback Amplifier Theory ; and Multiple-loop Feedback and Sensitivity.　　　A. S. G.

Introduction to Probability and Statistical Decision Theory. By G. Hadley. (Published by Holden-Day, Inc., 500, Sansome Street, San Francisco, U.S.A.), 1967. Pp. 580. Price $ 11.85.

Operations research or Management science is a new field of interest in modern years. A particular branch of this science is concerned with decision making, which helps the decision makers whether in industry, commerce, the military, or government to make proper decisions in the face of various types of problems confronting them. Every decision involves some element of uncertainty. In cases where the uncertainty is determinate its effect may be

small. In other cases the effect of uncertainty may become very significant. Statistical Decision Theory is concerned with the development of techniques for making decisions in situations where uncertainty plays a crucial role. How mathematics and mathematical models can help in making decisions are explained in this book whose author is a professor of mathematics and also connected with business interests.

A sound understanding of the elements of probability theory is needed in decision theory, and this is treated in considerable detail. Modern theory of utility is also important, and a chapter is devoted to this. Emphasis is based on Bayesian approach of using the law of conditional probability to decision theory. The book which is essentially mathematical, but includes a large number of problems of a practical nature, should interest students of business, economics or engineering who have had no previous training in this area. A. S. G.

Topology. By G. McCarty. (Published by McGraw-Hill Book Company, 330, West 42nd Street, New York 10036), 1967. Pp. 270. Price $ 8.95.

Written by a teacher and a specialist on algebraic topology of groups and H-spaces, this text provides an introduction with application to topological groups. It will meet the needs of graduate students for a one-year course on set-theoretic topology. The text emphasises the quotient-function—equivalence concept and gives a uniform treatment in the contexts of sets, groups, spaces, and topological groups stressing aspects common to all these settings.

The subject-matter is covered under the following major heads : Sets and Functions ; Groups ; Metric Spaces ; Topologies ; Topological Groups ; Compactness and Connectedness ; Function Spaces ; The Fundamental Group ; The Fundamental Group of the Circle ; and Locally Isomorphic Groups. The Exercises and Problems given at the end of each chapter will help students to learn the subject chapter by chapter, and thus get familiarised with the diligent use of topological techniques.

Annual Reports in Medicinal Chemistry—1966. Editor-in-Chief : C. K. Cain. (Academic Press, Inc., Publishers, 111, Fifth Avenue, New York, N.Y. 10003), 1967. Pp. 368. Price $ 7.95.

This is the second volume of the annual serial publication in paperback form issued by the Academic Press and being sponsored by the Division of Medicinal Chemistry of the American Chemical Society. The volume critically summarises the significant contributions concerning various fields of medicinal chemistry which appeared in literature during the year 1966. Nearly fifty specialists have contributed to this volume, and all major papers that have been published in various journals during the year have been reviewed. The 35 articles contained in this volume are grouped under the following main heads : CNS Agents ; Pharmacodynamic Agents ; Chemotherapeutic Agents ; Metabolic Diseases and Endocrine Functions ; Topics in Biology ; and Topics in Chemistry.

Besides to workers in the fields of chemistry, pharmacology, medicine and biology, these volumes should be of value to those interested in the development, use and marketing of drugs. A. S. G.

Stationary Random Processes. By Yu. A. Rozanov. (Published by Holden-Day, Inc., 500, Sansome Street, San Francisco, U.S.A.), 1967. Pp. 211. Price $ 12.00.

This book offers a rigorous discussion of the theory of prediction and interpolation of multi-dimensional stationary processes. The original in Russian, based on a course of lectures given by the author at Moscow University, has been translated into English with additions supplied by the author, and various minor corrections.

The contents of the book are under the folowing chapters : 1. Harmonic Analysis of Stationary Random Processes ; 2. Linear Forecasting of Stationary Discrete-Parameter Processes ; 3. Linear Forecasting of Continuous-Parameter Stationary Processes ; and 4. Random Processes, Stationary in the Strict Sense.

The Silkworm and its Culture. By Dr. S. N. Chowdhury. (The author, Principal, Sericultural Training Institute, Titabar, Assam), 1967. Pp. 76. Price Rs. 5.

The author who now heads the Government of Assam Sericultural Research Station at Titabar, has provided in this little illustrated publication a full but concise account of the mulberry silkworm, its life-cycle, development and its culture. The author has made the account scientific and popular so as to be of interest to the lay reader and the student alike. A. S. G.

ERRATUM : *Vol. 36, No. 23, Dec. 5, 1967.*

In the place of line 20 of the left column of p. 623 read "For the present synthesis 2-hydroxy-4-allyl-"

Books Received

The Correspondence of Isaac Newton (Vol IV). Edited by J. F. Scott. (Cambridge University Press, London N.W. 1), 1967. Pp. xxxii + 577. Price £ 11-11 sh.

The Origin of Continents and Oceans. By A. Wegener. (Dover Publications, 180, Varick Street, New York), 1967. Pp. v + 246. Price $ 2.00.

Early Nineteenth Century European Scientists. Edited by R. C. Olby. (Pergamon Press, Oxford), 1967. Pp. xi +179. Price 27 sh. 6 d.

A First Course in Abstract Algebra. By J. B. Fraleigh. (Addison-Wesley Publishing, Co., Reading, Mass.), 1967. Pp. xvi + 447. Price 53 sh.

Topology an Introduction with Application to Topological Groups. By G. McCarty. (McGraw Hill Book, Co., 330, West 42nd Street, New York 10036), Pp. xiii + 270. Price $ 8.95.

Vectors Matrices and Group Theory for Scientists and Engineers. By C. A. Hollingsworth. (McGraw Hill Book, Co., 330, West 42nd St., New York 10036), 1967. Pp. ix + 355. Price $ 10.50.

Announcements

Award of Research Degree

Andhra University has awarded the Ph.D. degree to the following : Shri B. V. S. Sarma (Chemistry) ; Shri V. Subrahmanyam and Shri M. L. Narayana Rao (Technology). Shri P. J. A. Rajaram (Nuclear Physics).

The University of Jammu and Kashmir has awarded the Ph.D. degree in Chemistry to Shri K. L. Handa.

Osmania University has awarded the Ph.D. degree in Physics to Shri G. Gopala Krishna and in Biochemistry to Shri N. Raghuramulu.

Sri Venkateswara University has awarded the Ph.D. degree in Geology to Shri K. L. Narasimha Rao and in Botany to Shri K. Ramalingeswara Rao and Shri G. Sitarami Reddi.

International Symposium on Turbulence of Fluids and Plasmas (16-18, April 1968)

Turbulence of Fluids and Plasmas is the topic of the eighteenth in the Polytechnic Institute of Brooklyn series of annual international symposia. The symposium will be held at the Waldorf-Astoria Hotel in New York City on 16–18 April 1968.

There will be a number of invited papers dealing with the models, physical phenomena and methods attendant upon a turbulent state, accompanied by contributed papers, illustrative of the general methods. Consideration will be given to experimental techniques which are employed to investigate a turbulent state, including "interactions", electromagnetic, optical, and acoustic, to the extent that these interactions are used to probe turbulence.

Contributed papers are invited up to the deadline of 15 January 1968. For consideration, a 500-word abstract should be submitted. Please address all correspondence to : P.I.B. Symposium Committee, 333, Jay Street, Brooklyn, N.Y. 11202, Attn.: Jerome Fox, Executive Secretary.

Symposium on Corals and Coral Reefs (12-16 January 1969)

The Marine Biological Association of India proposes to hold a Symposium on Corals and Coral Reefs on 12–16 January 1969 at Mandapam Camp, India. Contributions are invited on the following subjects : Systematics, Distribution, Physiology, Histology and Histochemistry, Biology, Reproduction, Physiology and Evolution, Formation, Structure and Ecology of Coral Reefs, Animal and Plant Communities in Reefs, etc. Titles of Contributions will be registered up to 31st July 1968, abstracts should reach by 31st August 1968 and the full papers by 31st October 1968.

Further information may be obtained from the Convener, Symposium on Corals and Coral Reefs, Marine Biological Association of India, Marine Fisheries P.O., Mandapam Camp, Madras State, India.

Textile Association—Silver Jubilee Conference

The Textile Association (India) will hold its Silver Jubilee Conference in New Delhi on 13 and 14 April 1968. Some special features of the Conference will be : (1) Lectures by experts connected with textile industry ; (2) A Workshop for an intensive 3-day discussion by selected professionals. (3) Technical sessions on spinning, weaving and chemical processing; (4) General sessions on "Modernisation, Marketing and Export Promotion" and "Education and Training in Textile Industry" ; (5) Publication of a Commemoration Volume on current status of the Textile Industry.

Further details can be had from the Organizing Secretary, Silver Jubilee Conference—The Textile Association (India), Delhi Branch c/o Shri Ram Institute, 19, University Road, Delhi-7.